Compressed Air Magazine

VOLUME 46 · NUMBER 10
OCTOBER 1941
LONDON · NEW YORK · PARIS

CLEANING A STEEL CASTING WITH AIR-POWERED GRINDERS

"WITHIN 5 MINUTES, THAT COPPUS BLOWER MADE THE CITY'S WORST MANHOLE FIT TO WORK IN"

ANOTHER COPPUS BLUE RIBBON PRODUCT

One of the country's biggest public utilities tested a Coppus Cable Manhole Ventilator at a spot picked for having the worst conditions in the city. "As soon as the blower was started, an immediate upward rush of steam and gases was noticeable, and within 5 minutes after starting, a man went down in the hole and pronounced it fit to work in."

Blowers for Oil Refineries, Boilers, Chemical Plants, Many Other Cooling and Exhausting Jobs

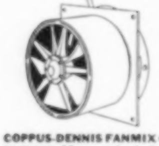
Besides ventilators for manholes, tanks and tank cars, — Coppus has a varied line of Blue Ribbon Blowers, Exhausters and Heat Killers, for purifying air or cooling materials or cooling men in the shortest possible time. Each is built on the Coppus principle, "Designed for your Industry — Engineered for You," a specialized product for the job, not a catch-all piece of equipment. Each has the Coppus Blue Ribbon, mark of precision workmanship and careful inspection.

Write today, mentioning your industry and types of air exhausting, ventilating and cooling jobs you want done. We will send you further free information on Blue Ribbon products to serve your needs.

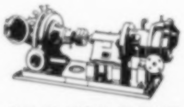
Coppus Engineering Corporation, 225 Park Avenue, Worcester, Massachusetts. Sales Offices in THOMAS' REGISTER; other "Blue Ribbon" products in SWEET'S.

COPPUS BLUE RIBBON PRODUCTS

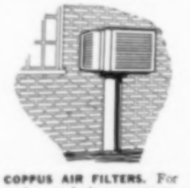
Designed for your Industry
Engineered for You



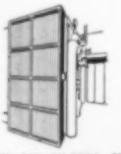
COPPUS-DENNIS FANMIX GAS BURNER. New method of mixing gas and air insures perfect gas-air ratio—instant, complete combustion. Bulletin 410-2



COPPUS STEAM TURBINES. For small H.P jobs — six sizes (and prices) from 150 H.P down to fractional. Steam — Gas — or compressed air driven. Bulletin 135-9.

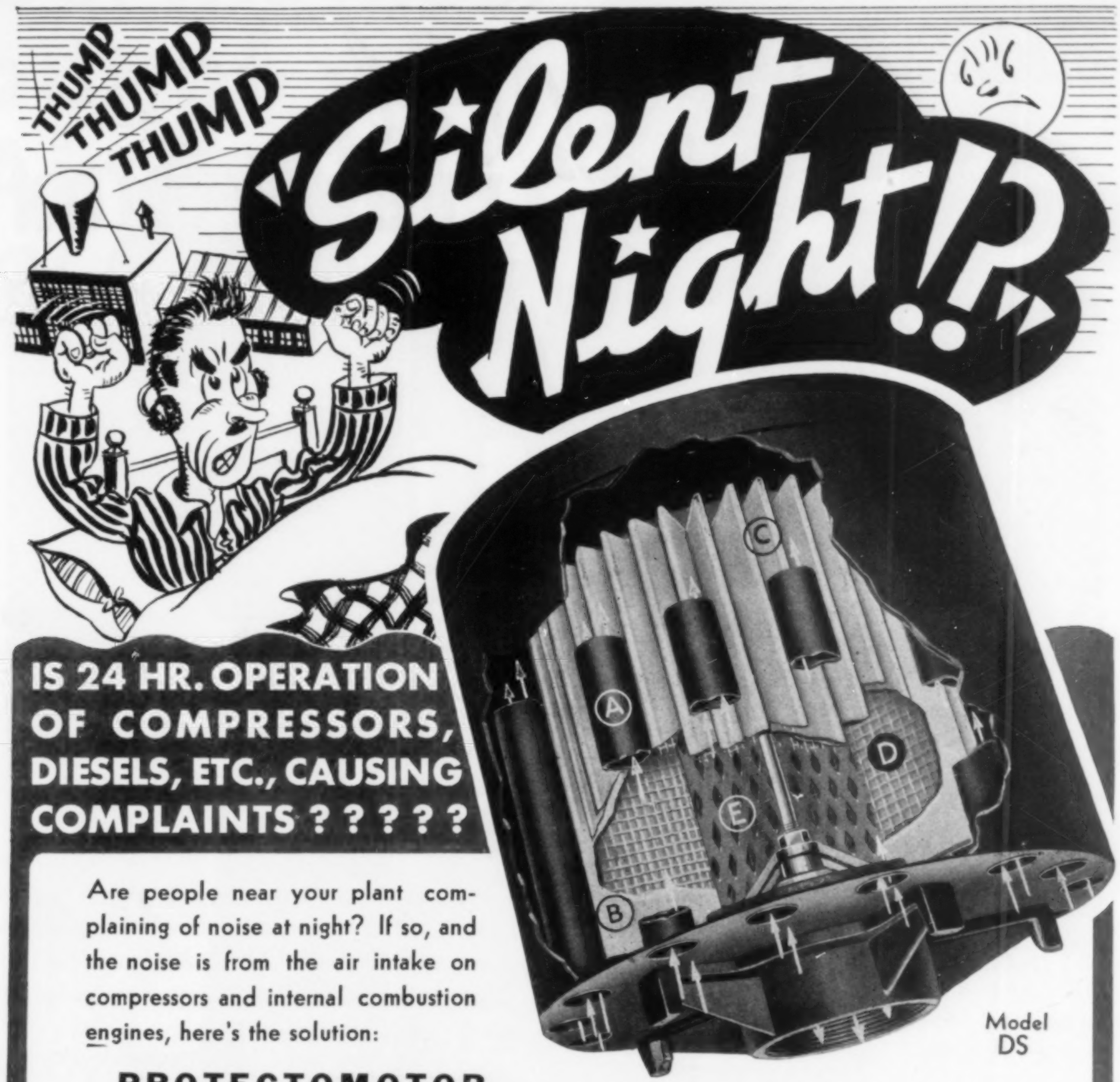


COPPUS AIR FILTERS. For engines and air compressors. Perfect, uninterrupted filtration. Bulletin F 310-4.



COPPUS AIR FILTERS. Unit type for industrial air conditioning and process work. 95.6% efficient for 2 micron dust particles. Bulletin F-320-4

COPPUS



IS 24 HR. OPERATION OF COMPRESSORS, DIESELS, ETC., CAUSING COMPLAINTS ? ? ? ? ?

Are people near your plant complaining of noise at night? If so, and the noise is from the air intake on compressors and internal combustion engines, here's the solution:

PROTECTOMOTOR
SILENCER-FILTER FOR ENGINE INTAKE

The Model DS Silencer-filter hushes the most raucous air intake—plus preventing the entry of abrasive foreign matter. It's a double duty filter—helping to prevent complaints due to night operation, saving excess wear on engines and compressors due to intake of abrasive dust. More than 500,000 Protectomotors of similar construction have been sold since 1920. Quickly and easily installed, the Model DS provides capacities and threaded or flanged connections for any engine or compressor.

MODEL DS CONSTRUCTION FEATURES

- A. Series of cylindrical rectifying chambers of scientific diameter to length ratio which smooths out sound waves.
- B. Dry Feltex Filtering Medium 99.8% efficient by University of California Laboratory tests.
- C. Radial Fin Construction. Permits large area of filtering medium to occupy smallest possible space.
- D. Rigid, galvanized mesh frame.
- E. Reinforcing tube. The Model DS Protectomotor is "built like a battleship."

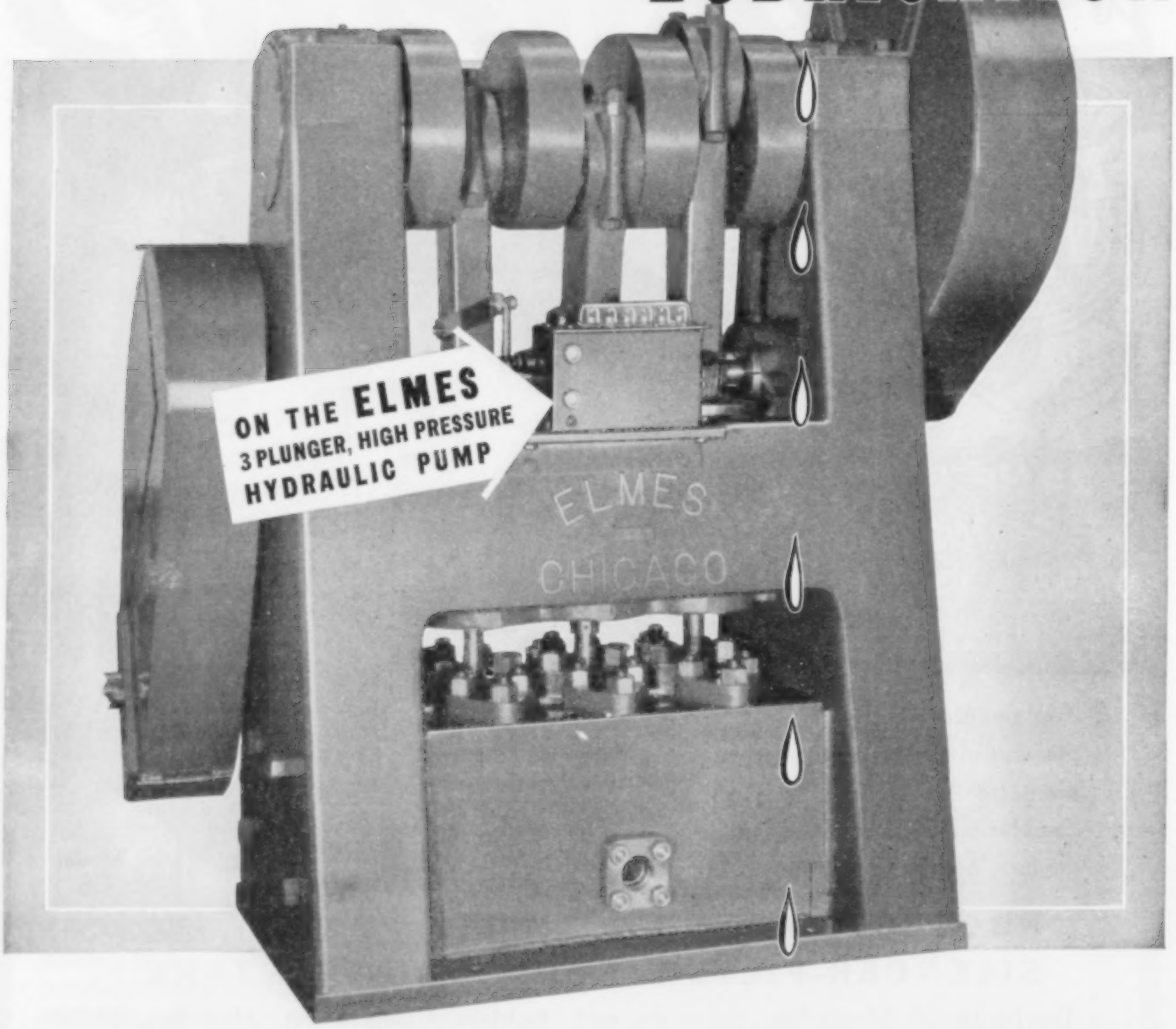
Always Reduces Engine Wear - - May Prevent a "Nuisance Action"

NEW CATALOG
44 pages, completely illustrates and describes filters for ventilation and pipe lines as well as engine intake. . . . . .

STAYNEW FILTER CORP.
7 LEIGHTON AVE., ROCHESTER, N. Y.
"*Air Filter Headquarters*"

PROTECTOMOTOR 99 9/10 Per Cent EFFICIENT AIR FILTERS

MADISON-KIPP *Fresh Oil* LUBRICATION



ON THE ELMES 3 PLUNGER, HIGH PRESSURE HYDRAULIC PUMP

STANDARD EQUIPMENT EVERYWHERE.. *because* FLEXIBLE TO EVERY APPLICATION

On machine tools, work engines, compressors and all types of high grade machinery . . . Madison-Kipp Lubricators are specified as stanard equipment by more and more manufacturers. Illustration shows a Madison-Kipp Lubricator on the Elmes 3-Plunger, High Pressure Hydraulic Pump manufactured by Charles F. Elmes Engineering Works, Chicago, Illinois.

Madison-Kipp has a particularly marked advantage in engineering original equipment installations because of having 43 years experience in designing and manufacturing all types of pressure-fed lubricator instruments. Madison-Kipp will be pleased to have you consult them on any original equipment lubrication problems requiring fresh oil by the measured drop, fed under pressure.

MADISON-KIPP CORPORATION
202 Waubesa Street, Madison, Wis., U. S. A.

Complete DIE CASTING SERVICE · FRESH OIL LUBRICATORS · HIGH SPEED AIR TOOLS

Get the most out of your Air Tools . . .

Check...

AIR LINES
PIPE CONNECTIONS
HOSE FITTINGS

The transmission of compressed air is so simple that it is too often taken for granted. It is extremely important to maintain adequate air pressure at the tools. They will often do 40% more work with 90 lbs. air than with 70 lbs. air. Make periodic checks on your air lines.

Reduce friction losses by using adequate hose and pipe sizes. Keep them short and avoid unnecessarily long or small fittings which cause a sharp reduction in pressure.

A little checking here and there throughout the plant will greatly improve the effectiveness of your tools. Why not make it one man's job to look into this matter?

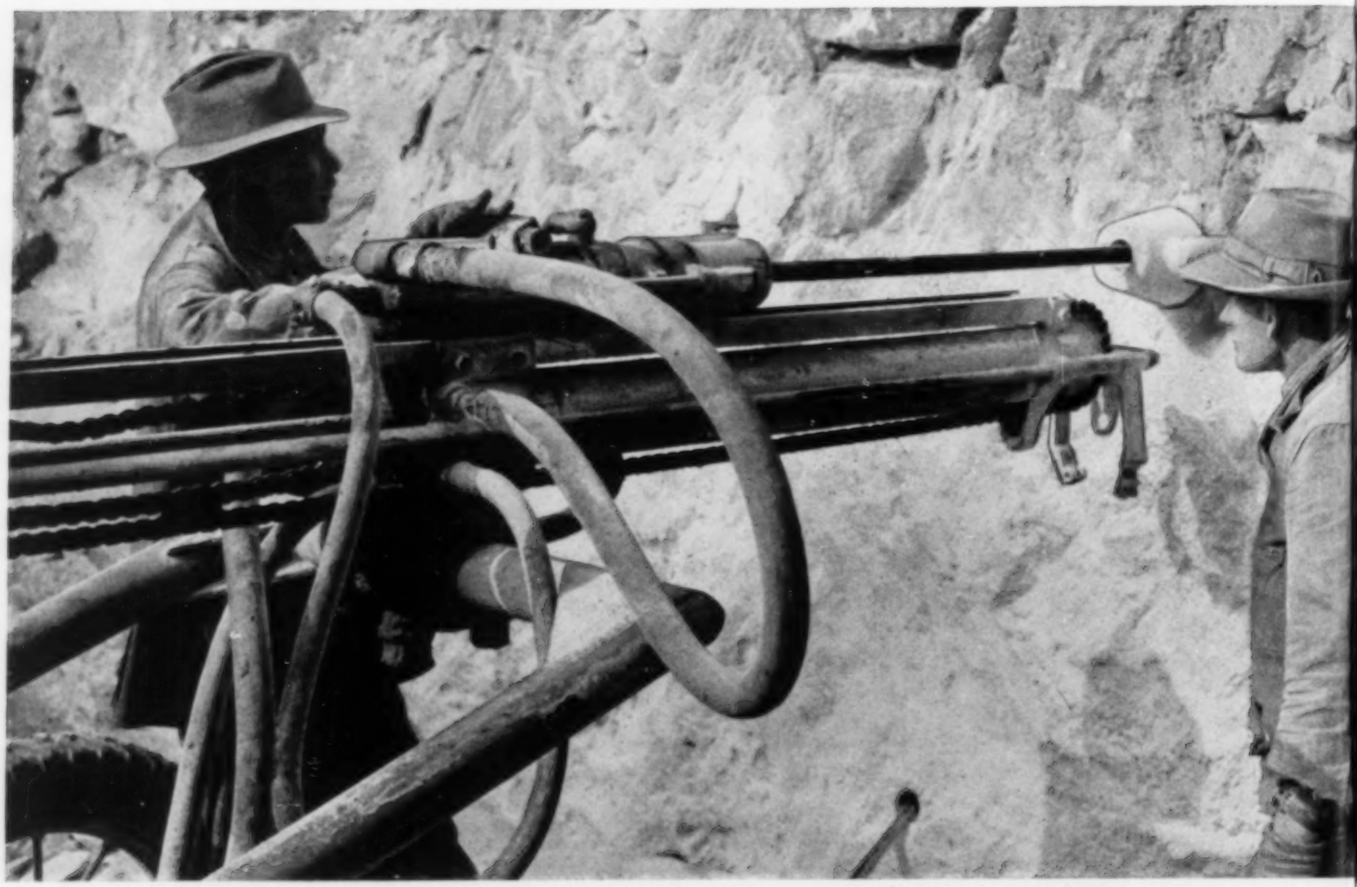
Ingersoll-Rand

8-44 11 BROADWAY, NEW YORK CITY

MAINTAIN 90-LB. AIR PRESSURE FOR BEST RESULTS

GARGOYLE VOCO ENGINE OIL NO. 1 IN YOUR AIR DRILLS

Won't Wash Off!



CALL IN Socony-Vacuum for

YOU'LL BENEFIT FROM: 75 YEARS' LUBRICATION EXPERIENCE • PRODUCTS APPROVED BY ENGINE BUILDERS •

ONE OF OIL'S TOUGHEST JOBS is keeping your air drills at top efficiency. Here's how Gargoyle Voco Engine Oil No. 1 does it:

This fine oil seals the piston against power-wasting "blow-by." It minimizes costly cylinder wear with a tough lubricating film . . . functions at low temperatures to prevent valve sticking.

But, above all, Voco Engine Oil No. 1 doesn't wash off! It sticks tight—even under constant washing by moisture entering with the air.

That kind of protection means less worry and expense for you.

GARGOYLE

Lubricants

The Emblem of
75 YEARS' PIONEERING
in "Correct Lubrication"
1866-1941

"Correct Lubrication"

THE RIGHT OIL FOR EACH JOB • NEW LUBRICANTS AHEAD OF NEW NEEDS •

SOCONY-VACUUM OIL COMPANY, INC. • Standard Oil of New York Div. • White Star Div. • Lubrite Div. • Chicago Div. • White Eagle Div. • Wadhams Div. • Southeastern Div. (Baltimore) • Magnolia Petroleum Co. • General Petroleum Corp. of Calif.

Canada's Famous Mines SPEED Vital Development Work WITH

EIMCO-FINLAY LOADERS

SLADEN-MALARTIC

MALARTIC GOLD FIELDS

FALCONBRIDGE

KERR-ADDISON

In Canada, today, ALL metals are urgently needed to help defend the Empire and the loyal officials of her many famous mines are straining every nerve to increase production. Skilled labor is becoming scarce yet development work is being speeded up more rapidly than ever before—largely through effective use of many Eimco-Finlay Loaders.

One Canadian mine manager says, "We are using your loader three shifts per day in an 8' x 10' crosscut, averaging 19 ft. advance every 24 hours, and estimate that it has already more than paid for itself. No repairs or replacements have yet been required."

Another says, "We tried another type of mucking machine with unsatisfactory results but the Model 21 Eimco-Finlay has proved a natural for the job. It fills our 35 cu. ft. cars in about one minute and our 65 cu. ft. cars in less than two minutes."

Already out-performing any other mucking machines of comparable type both the Model 12-B and Model 21 Eimco-Finlay Loaders have recently been raised to still greater heights of superiority by the introduction of new high-torque, high-power, five-cylinder, radial air motors, developed especially for this purpose by the Ingersoll-Rand Company and containing many improved features which assure longer life with lower maintenance expense. Mining men who have marveled at the low maintenance cost of other Eimco-Finlay Loaders will find our present machines equally durable, notwithstanding their greater speed and power.

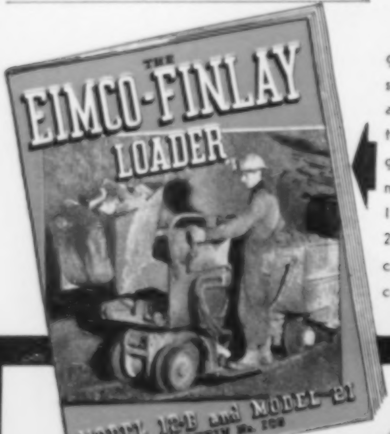
Bulletin 105 (36 large fully-illustrated pages) gives complete information regarding the design, construction and operation of Model 12-B and Model 21 Eimco-Finlay Loaders. Really a text-book on mechanical mucking. Bulletin 106 gives all essential information regarding the new Model 40 Eimco TUNNELOADER with 12 cu. ft. bucket, power-operated swing, and 28" stub-conveyor, for loading the largest cars used underground. Powered by either compressed-air or electric motors.

THREE STANDARD SIZES NOW MEET ALL UNDERGROUND REQUIREMENTS

The Model 12-B Eimco-Finlay Loader can be used effectively in drifts as small as 4'-6" wide by 6 ft. high—loads cars up to 50 cu. ft. capacity at the rate of two tons per minute. Model 21, with wider clean-up, loads larger cars at the rate of two tons per minute. Model 40 loads the largest cars used underground at the rate of more than three tons per minute. Illustrated bulletins give complete information. Write for free copies.

PARTIAL LIST OF CANADIAN USERS

- Beattie Gold Mines, Ltd.
- Belleterre Quebec Mines, Ltd.
- Bidgood Kirkland Gold Mines, Ltd.
- Bonetal Gold Mines, Ltd.
- Bralorne Mines, Ltd.
- Britannia Mining & Smelting Company, Ltd.
- Broulan Porcupine Mines, Ltd.
- Buffalo Ankerite Gold Mines, Ltd.
- Chesterville Larder Lake Gold Min. Co., Ltd.
- Cons. Min. & Smelting Co. of Canada, Ltd.
- De Santis Porcupine Mines, Ltd.
- Dome Mines, Ltd.
- East Malartic Mines, Ltd.
- Falconbridge Nickel Mines, Ltd.
- Granby Cons. Min., Smelting & Power Co., Ltd.
- Guysborough Mines, Ltd.
- Hallnor Mines, Ltd.
- Hard Rock Gold Mines, Ltd.
- Hollinger Consolidated Gold Mines, Ltd.
- International Nickel Co. of Canada, Ltd.
- Island Mountain Mines Company, Ltd.
- Isle Mountain Gold Mine
- Kerr-Addison Gold Mines, Ltd.
- Lake Shore Mines, Ltd.
- Luscar Coal Company
- Malartic Gold Fields, Ltd.
- Matachewan Consolidated Mines, Ltd.
- McIntyre Porcupine Mines, Ltd.
- Mic-Mac Mines, Ltd.
- Noranda Mines, Ltd.
- Normetal Mining Corp., Ltd.
- Northern Empire Mines Company, Ltd.
- Omega Gold Mines, Ltd.
- Pamour Porcupine Mines, Ltd.
- Paymaster Consolidated Mines, Ltd.
- Pioneer Gold Mines of B. C., Ltd.
- Posperpine Gold Mining Company
- Reno Gold Mines, Ltd.
- Ross Mines
- San Antonio Gold Mines, Ltd.
- Sigma Mines, Ltd.
- Siscoe Gold Mines, Ltd.
- Sladen Malartic Mines, Ltd.
- Sullivan Consolidated Mines, Ltd.
- Sylvanite Gold Mines, Ltd.
- Tech-Hughes Gold Mines, Ltd.
- Toburn Gold Mines, Ltd.
- Vicour Gold Mines, Ltd.
- Waite Amulet Mines, Ltd.
- Wood Cadillac Mines, Ltd.



Our Guarantee

Year after year, far more Eimco-Finlay Loaders are manufactured and sold than all competitive types combined, and their inherent superiority has been so thoroughly proved that every machine sold now carries a positive money-back guarantee that it will outlast and out-perform any other mucking machine of comparable size and type at any air pressure, and under any working condition.

THE EIMCO CORPORATION

SALT LAKE CITY, UTAH, U. S. A.

NEW YORK, 120 Broadway
EL PASO, Mills Bldg.

CHICAGO, 111 W. Washington St.
SACRAMENTO, 1217 7th St.

INGERSOLL-RAND CO., LTD.
165 Queen Victoria St., London, Eng.

* BRITISH MIN. SUP. CO. (PTY.), LTD.
Troye House, Johannesburg, S. A.

* HODGSON & CRANSTON
Boulder Road, Kalgoorlie, Australia

CLYDE ENGINEERING LTD.
Wellington, New Zealand

* MINE EQUIPMENT COMPANY LTD.
Kirkland Lake, Ontario, Canada

* B. C. EQUIPMENT CO., LTD.
551 Howe St., Vancouver, B. C.

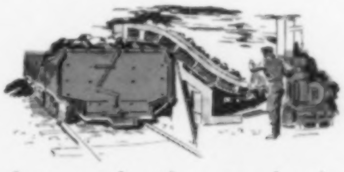
* MARSMAN TRADING CORPORATION
Manila and Baguio, Philippine Is.

INTERNATIONAL MACHINERY CO.
Rio de Janeiro, Santiago and Antofagasta

** Replacement parts carried in stock by agents indicated by asterisks*

Pete sees mechanized mining improving

"THINGS sure have changed. When I first came to work in these mines, we didn't have undercutting machines, mechanical loaders, and other mechanized equipment that speeds up coal mining. And we didn't have modern permissibles either.



"When mechanization did come in, we found that it wasn't so easy to get nice lump at first. Then Hercules service men showed us how easy it was to get the right size coal by using the right Hercules permissibles.

"Of course, you know Hercules pioneered in introducing high-count permissibles. That's because Hercules has always believed in research to make better explosives. Why, they tell me that Hercules has a new machine that can even take a picture of a stick of dynamite exploding.

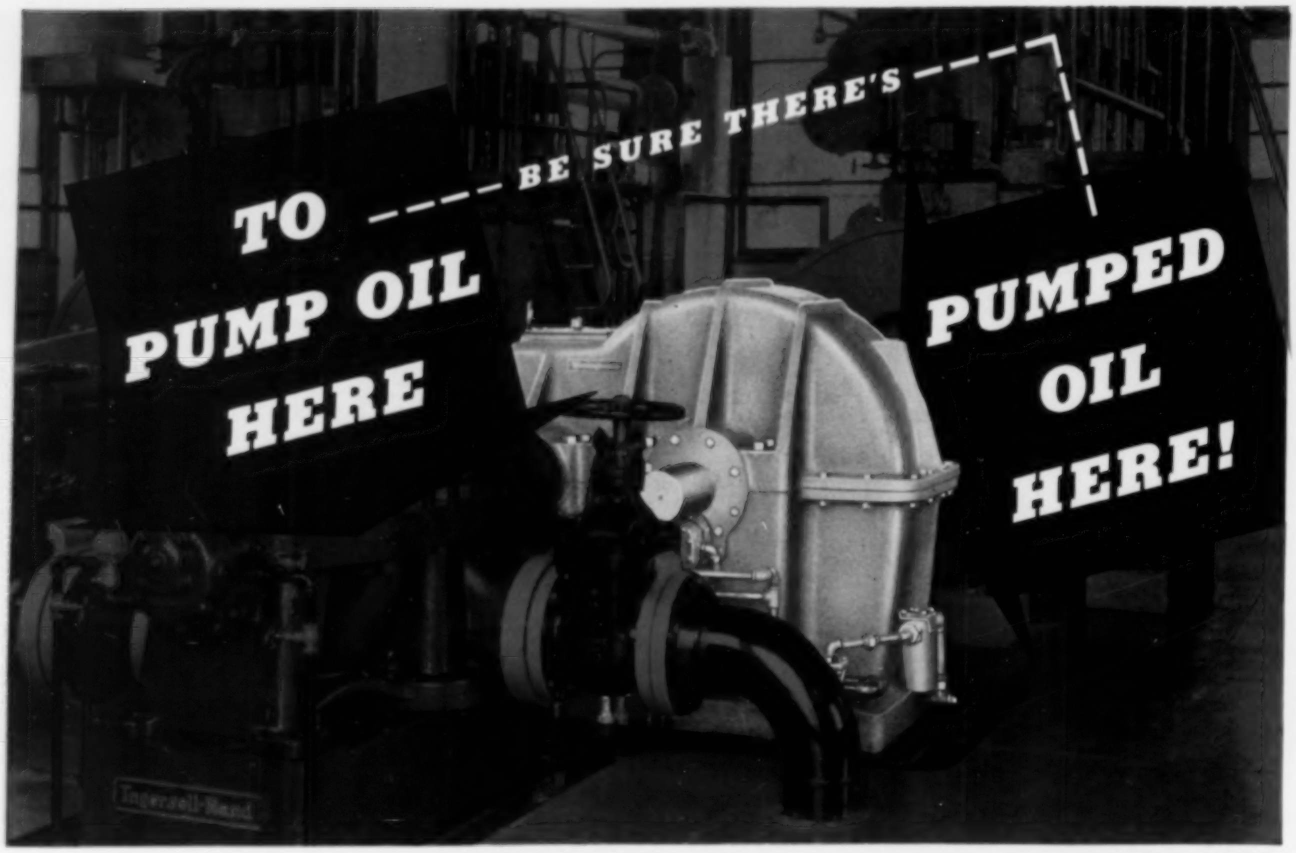
"No matter what kind of coal you're mining—or what kind of mechanical equipment you are using—there's a Hercules powder that will shoot it just the way you want it, and a Hercules service man to help you. If that's not reason enough to stick with Hercules, I'll give you another. The company that's been first with so many new improvements is mighty likely to be first all the time."

HERCULES POWDER COMPANY
INCORPORATED
932 KING STREET, WILMINGTON, DELAWARE
●Reg. U. S. Pat. Off., by Hercules Powder Co.

B-57

HERCULES

EXPLOSIVES AND BLASTING SUPPLIES

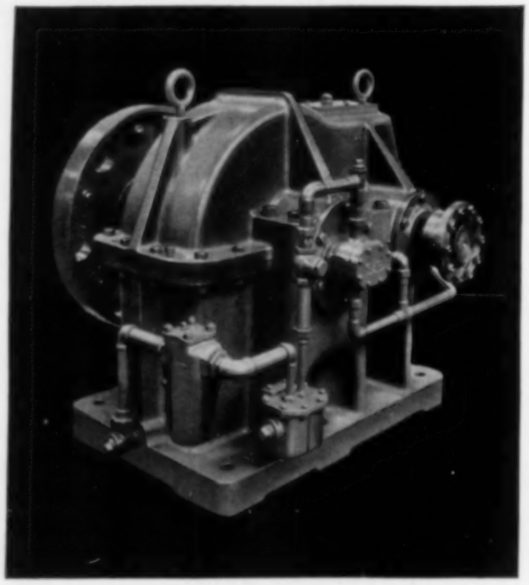


PRESSURE-LUBRICATED SPEED INCREASERS INSURE LONG-LIFE DRIVES

For oil to flow dependably through pipe lines, oil must flow dependably to the high-speed gears that drive the pumps. Westinghouse Speed Increasers insure quiet, continuous operation for pumps, compressors and similar equipment, because their lubrication is insured by positive pressure feed.

Oil pumped constantly against the mesh line of the gears prevents gears or bearings from ever running dry. All parts of the circulating lubrication system are externally mounted and easily accessible.

Westinghouse Speed Increasers are individually designed to exact requirements of prime mover and the machine they are to drive. They can be used to increase output speeds of Diesel engines, gas engines or electric motors. Write for booklet DD-3650 containing details and application data. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.



Westinghouse Type SU-14-8 Speed Increaser showing forced-feed lubrication system with pump, cooler and strainer externally mounted.

J-07188

Westinghouse Geared Drives

WESTINGHOUSE W

A YEAR'S DELAY SAVED BY BRONZE WELDING!

Fractured spokes of 24 ft. flywheel repair-welded with Anaconda 997 Low-Fuming Bronze Rod in 56 man hours

When two spokes of this giant flywheel were broken, it appeared as though a blast furnace with scheduled defense production would be out of operation for a long time.

The Hebeler Welding Company, Buffalo, was called in as soon as it was learned that a new wheel probably could not be delivered for a full year.

In just 56 man hours, the Hebeler men completed the job with about 300 pounds of Anaconda 997 Low-Fuming Welding Rod. An insurance company then insured the repaired wheel, which once again proves the statement that good workmanship plus a good material equals dollars—and time—saved!

41137-A

ANACONDA from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Company

For stepped-up production . . .

BETHLEHEM TRACK EQUIPMENT

The endless needs of National Defense demand that track equipment be more rugged to stand the gaff of stepped-up production. Whatever you need in trackwork, for permanent or temporary installation, you'll find Bethlehem can fill the bill. From steel ties to complete crossings and turnouts, Bethlehem Track Equipment is designed for fast installation, low maintenance and maximum ruggedness. For complete details, write to Bethlehem Steel Company, Bethlehem, Pa. for Booklet 72A.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

CARBORUNDUM
ABRASIVE PRODUCTS

GET MORE FOOTAGE

between regrinds of detachable bits

● For more footage between regrinds, your detachable bits must be accurately gauged and formed. Cutting edges must be square with the shank. Corners must be sharp. And every bit should have the correct temper.

Any old grinding wheel won't do the job right. But you *can* get the results you want if you insist on Aloxite Brand Aluminum Oxide Wheels. These famous wheels will help you realize *every* advantage and economy of detachable bits.

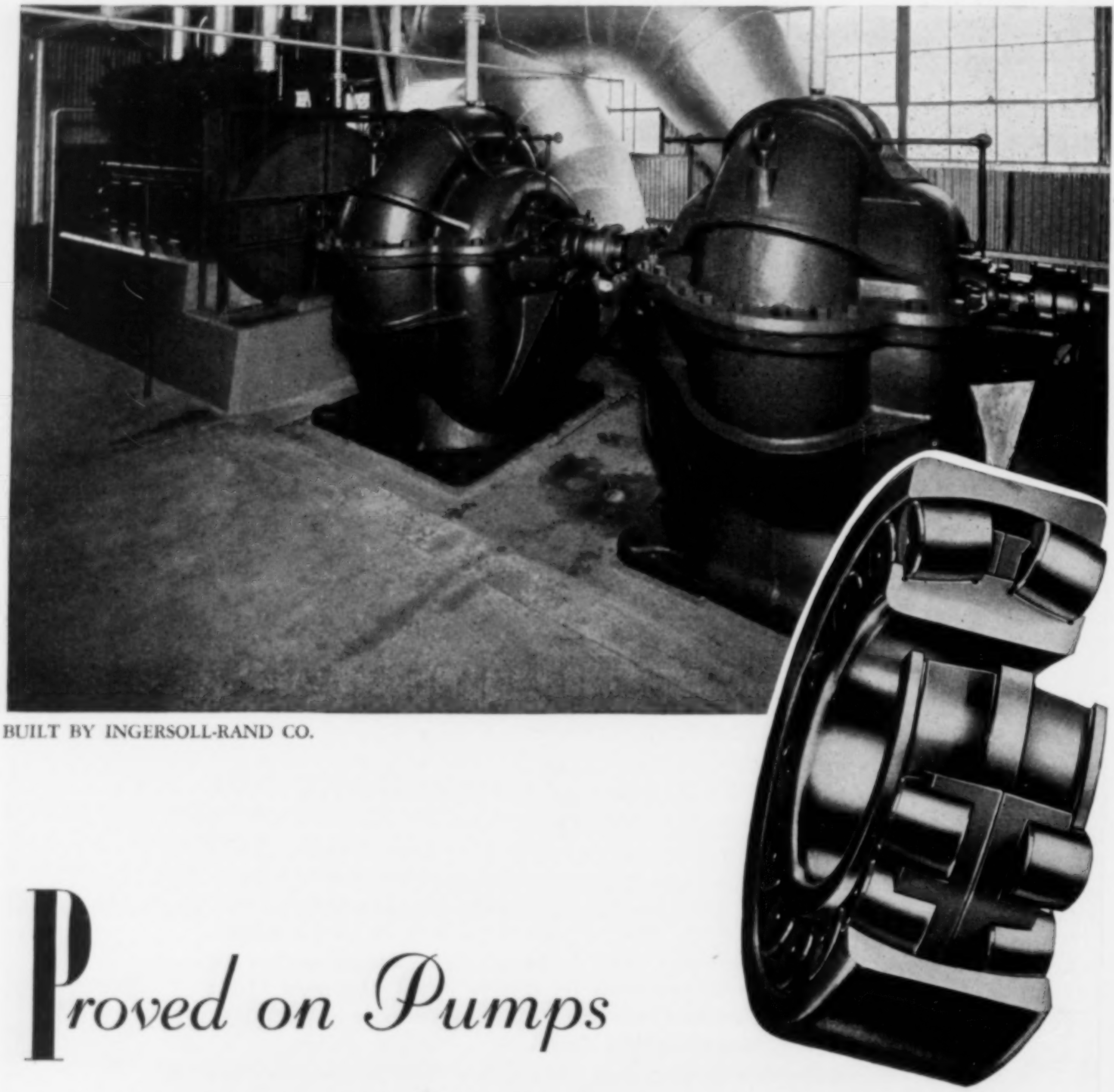
Aloxite Brand Wheels are built to hold their shape . . . to cut fast, free and cool. They not only assure you accurate gauge and form, retention of temper in the bit, longer tool life between grinds . . . they also reduce grinding time to a minimum and lower the cost of each grind.

Be sure to specify "Aloxite Brand" if you want more footage between regrinds *and* lowest grinding costs. Wheels available in the correct grit and bond for every requirement.

THE CARBORUNDUM COMPANY
REG. U. S. PAT. OFF.
Niagara Falls, N. Y.

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

(Carborundum and Aloxite are registered trade-marks of and indicate manufacture by The Carborundum Company)



BUILT BY INGERSOLL-RAND CO.

Proved on Pumps

IN YEARS OF SERVICE

Tried and proved bearings, those that have been selected for these 30-CFV Cameron Pumps. TRIED in long continuous service with each of these pumps conveying up to 25,000 gallons of water per minute at 280 r.p.m., 11-foot head. PROVED by their ability to avoid trouble . . . to take any combination of radial and thrust loads . . . to eliminate adjustments. Such things don't just *happen.* They're the result of more than a third of a century of research, of correct engineering application, of EXPERIENCE. And in these days of Defense-in-a-hurry, those are the things that count.

4886

SKF INDUSTRIES, INC., FRONT ST. & ERIE AVE., PHILA., PA.

ROLLER SKF BEARINGS

INDUSTRY'S FIRST FAMILIES *prefer* JOHN CRANE *Packings*

Quality! . . . Superlative quality! . . . Laboratory-proved quality!—is the one and only factor that has won this acceptance. Achieving and sustaining such quality is a foundational undertaking: basic materials, chemistry and metallurgy are fabricated to incorruptible standards; from receiving room to shipping skid a micrometric precision of production is exacted . . . This, and this only has made John Crane Packings standard equipment on the finest machines of our day . . .

CRANE PACKING CO., CHICAGO, U. S. A., CRANE PACKING CO., LTD., HAMILTON, ONTARIO, CANADA

Notable BOILER-FEED *Styles*

From our survey-files of thousands of installations, we submit four assemblies that have been specified as standard equipment by foremost pump manufacturers, and as standard practice by hundreds of top-rank industrial engineers.

RECIPROCATING SERVICE:

Equipment . . . Steel plungers or rods . . . steam piston rods . . . Medium pressures

Service . . . water . . . steam

Style 751 . . . John Crane Style Boiler-feed Pump Packing

Specifications . . . Combination set of alternate die-formed rings: Style 101 and 301. Style 101 is a flexible all-metallic packing made by spirally wrapping thin ribbons of soft babbitt foil, layer-over-layer construction and squared to size; each layer lubricated with oil and graphite. Style 301 is a flexible semi-metallic packing consisting of a soft babbitt foil securely fastened to a resilient asbestos channel. Low in friction; minimum gland adjustment.

CENTRIFUGAL SERVICES:

Equipment . . . Bronze sleeves . . . Medium or low pressure

Service . . . hot and cold water . . . steam

Style 1015 . . . John Crane Style Boiler-feed Pump Packing

Specifications . . . Composed of die-formed rings of Style 810, made from finest Canadian asbestos yarns by plaited braid method, each strand impregnated with graphite and special high-flash-point lubricant; soft, minimum friction.

Equipment . . . Medium hard sleeves (270 to 500 Brinnell)

Service . . . hot and cold water . . . steam

Style 1033 . . . John Crane Style Boiler-feed Pump Packing

Specifications . . . Combination set composed of Styles 101 and Super-Seal No. 1. Style 101 is a flexible metallic ring of low frictional metallic bearing and acts as a pressure breaker. The graphited Super-Seal No. 1 plastic rings effect proper seal along the shaft.

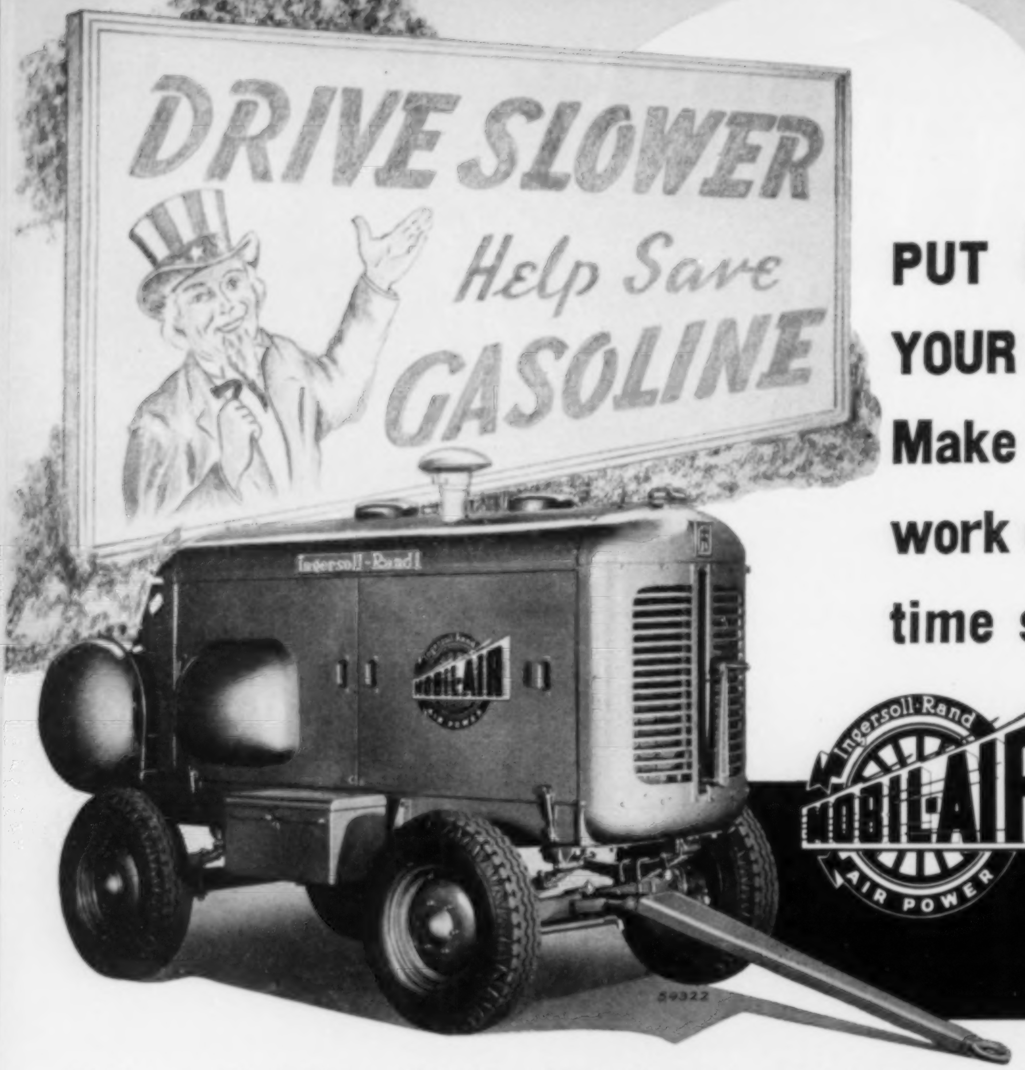
Equipment . . . Heavy duty; high pressure hard steel sleeves (500 Brinnell and over)

Service . . . Hot and cold water . . . steam

Style 805-MBF . . . John Crane Style Boiler-feed Pump Packing

Specifications . . . A highly effective style where high suction and discharge at high speeds are involved. Manufactured by braid-over-braid method from purest asbestos yarn reinforced with special wire insertion. Each strand lubricated with special boiler-feed lubricant. Recommended for stuffing boxes with or without lantern.

Styles illustrated above:
top: Spiral form of Style 100
bottom: Spiral form of Super-Seal No. 1, from both of which rings are die-formed to specified sizes.



PUT **MOBIL-AIR** ON YOUR CONSTRUCTION JOBS

Make 3 gallons do the work of 5...and at the same time speed-up your work

Ingersoll-Rand MOBIL-AIR AIR POWER

the COMPRESSOR that is Saving Thousands of Gallons of Gasoline

Your car may be built to go 70 miles an hour with ease, but you save gasoline if you drive it at 40. Similarly, by using MOBIL-AIR on your construction jobs, you will be making important fuel savings for National Defense. The MOBIL-AIR automatically slows down and works slower whenever you don't need its full capacity. *It's like driving your car continuously at 40 mph whenever you don't need to hurry; whereas the conventional portable is like always going 70, but stopping every few minutes (with your engine idling) so that you won't get there too soon.*

Provides Three Working Speeds . . . The patented DRILL-MORE Multi-speed Regulator *automatically selects the slowest and most efficient operating speed* that will maintain the required air pressure. It saves fuel, not only because it eliminates most of the usual wasteful idling periods, but because the average working speed of the compressor and engine is slower and more efficient.

Makes "Unbelievable" Savings in Fuel . . . Combining the economies made possible by its new convertible engine, its new two-stage air-cooled compressor and the DRILL-MORE Regulator, the MOBIL-AIR saves up to 40% in gasoline costs compared to the best previous Ingersoll-Rand model. Think what this means when compared to old, worn-out or obsolete portables—you really can't afford to run them. Users everywhere say that MOBIL-AIR savings are almost unbelievable.

Convertible to use Gasoline or Fuel Oil . . . Its Multi-fuel Engine can be converted from gasoline to oil or from oil to gasoline operation by a simple change of fuel accessories. You can always convert your MOBIL-AIR to take full advantage of the lowest-cost fuel in the particular area where you are operating, or to use whichever fuel is easier to obtain in case of a fuel shortage.

Speeds-up Your Work . . . By means of the DRILL-MORE Regulator, the MOBIL-AIR maintains more uniform and higher average air pressures compared to portables equipped with conventional regulators. This results in up to 15% faster drilling with Jackhamers and similar air tools.

The above features are standard on all K-Series MOBIL-AIR. Let our nearest representative tell you more about them and the many other money-saving features available only in MOBIL-AIR.

Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y. 2-90

A Complete Line of Two-Stage Air-Cooled Compressors . . . 60 to 500 cfm (actual free air at 100 lb.)

WE ALSO MAKE THE TOOLS THAT USE THE AIR

"Get it Done"

with the oil that keeps compressors going—

SHELL
COMPRESSA OIL

PRODUCTION SCHEDULES are soaring . . . compressors will be driven to the limits of their endurance, but stable Shell Compressa Oil keeps right on doing a top-notch lubricating job. Here's why: Shell Compressa Oil—

1—Is highly stable under the most severe operating conditions.

2—Prevents excessive formation of hard carbon deposits . . . does not break down at high compression temperatures. Retains its lubrication qualities.

3—Keeps discharge valves working freely . . . helps prevent ring sticking and blow-by.

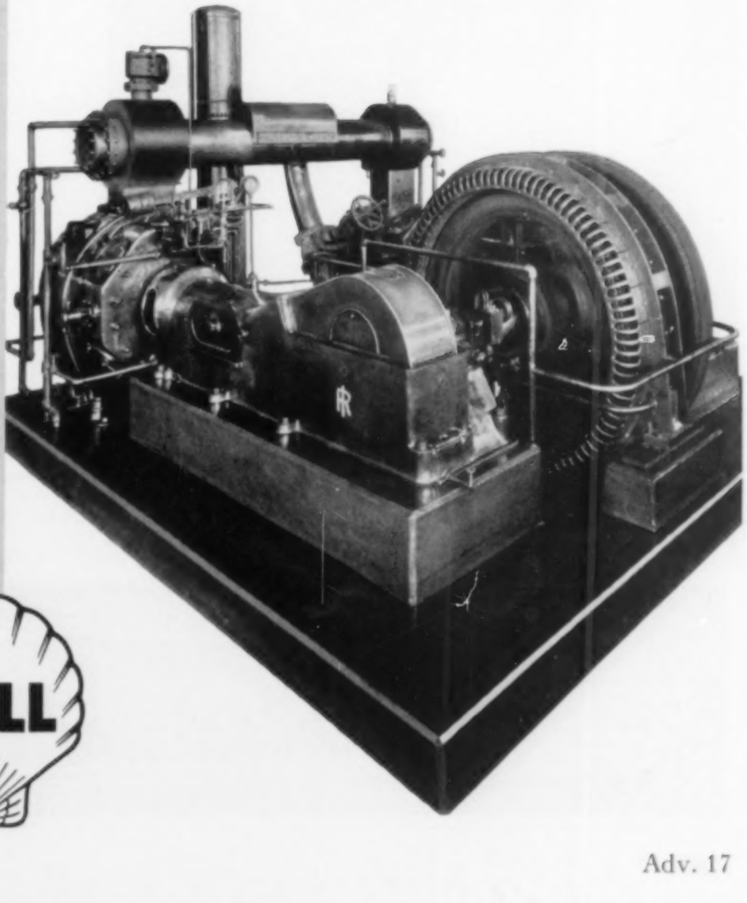
4—Reduces wear on all sliding and rotating parts.

5—Has high resistance to emulsification.

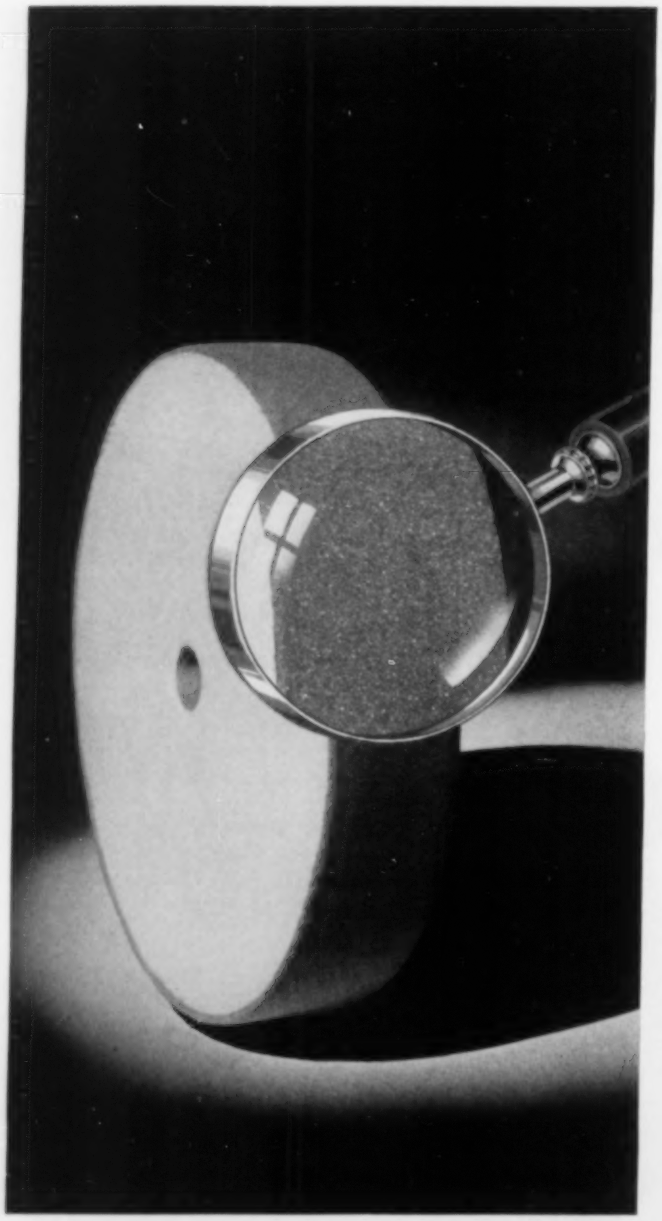
6—Assures low oil consumption by effectively sealing pistons.

Don't guess. *Know* your compressors are being lubricated as they should. Call in the Shell man today. His recommendations will be entirely practical—and will be made without obligation.

SHELL



What Does the Magnifying Glass Show About Your Polishing Wheels?



ARE the grains of abrasive uniform in size—no oversize grains to scratch? Are the grains solid and strong in shape—able to do a lot of real hard work? Are the grains holding firm in the glue or cement—ready to do their share?

If your polishing wheels won't meet the microscopic test you'll want to use Alundum Abrasive. Special screening methods assure accurate grain sizing; special crushing methods assure strong grain shape; special surface treatments assure high capillarity—ability to hold firm in the adhesive.

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ON THE COVER

OUR cover picture shows two sizes of Multi-Vane grinders being used to clean steel castings for the gear housing of a power shovel. With the present increased industrial activity, these and other air-powered tools are helping to speed operations in many plants.

●

IN THIS ISSUE

PIPE lines for transporting oil are commonplaces in many sections; but to New Englanders and Canadians they are somewhat of a novelty. That is one reason why the new system from Portland, Me., to Montreal, Canada, has attracted so much attention. Another reason is that it will release from service several tankers that are urgently needed elsewhere. In keeping with the tradition of the pipe-line constructor, the line is being built in a hurry despite the rocky terrain in its path. Our leading article describes the operations in detail.

●

THAT a gold-mining camp of importance could be developed in such an isolated area as Great Slave Lake is largely attributable to the high value of its ores. Some of them are among the richest so far discovered in Canada; and with a great expanse of land yet to be tested in the region, hopes of mining men that it will become one of the Dominion's greatest producers are running high. As our article on Yellowknife points out, aviation is playing a vital part in the development. Air-borne traffic to the northern mines during the first six months of this year consisted of 2,936 passengers and 666,764 pounds of express.

●

ANCIENT Pharaohs built pyramids for their own aggrandizement. Modern engineers, on the other hand, erect huge dams for the benefit of mankind. Untold thousands will have better lives because of the Central Valley Project in California, one of the key structures of which is Friant Dam. How this concrete monolith is being constructed will be told in a 2-part article of which the first installment appears in this issue.

●

NOT so many years ago the water supplies of some American cities were not adequately sterilized, and typhoid fever and other germ-borne diseases sometimes became epidemic. Chemical treatment rendered the water safe but often gave it unpleasant tastes. For a time these were accepted as inevitable: but recently there has been a demand for safety plus palatability. Fortunately this can now be met economically with ozone, which is obtained from air. The article starting on page 6568 describes one of the processes for generating and applying it.

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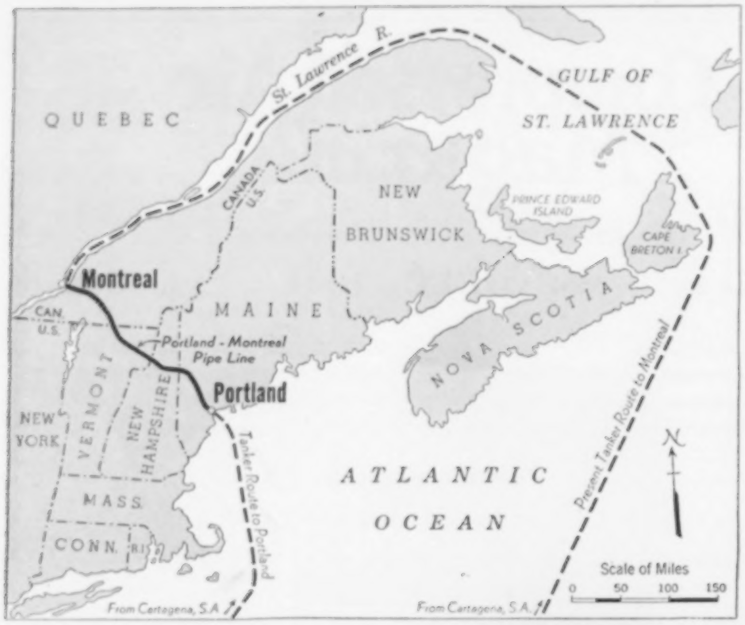
Oil to Montreal

W. H. O'Connell



HOW LINE WILL SAVE

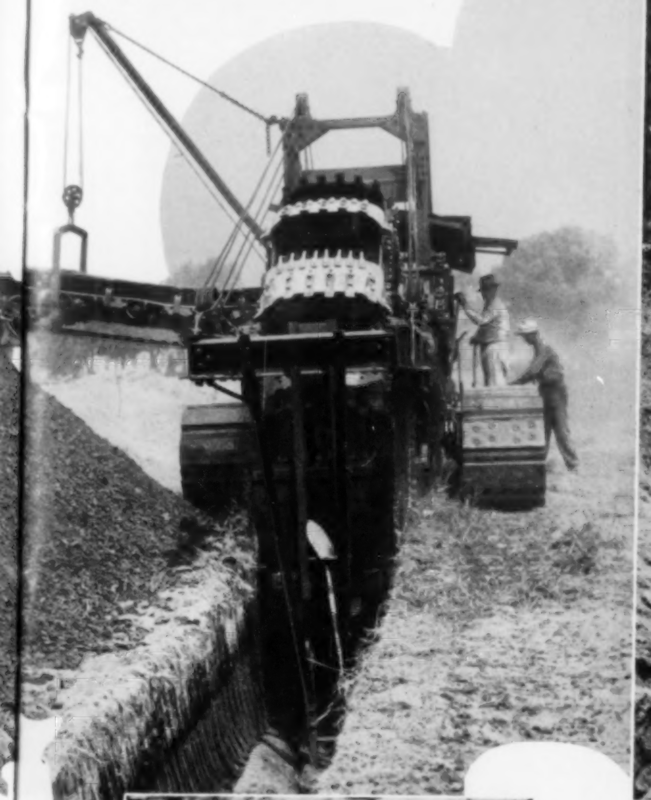
In the past, 96 per cent of the 1,280,000 barrels of oil annually moved from United States and South American fields to the Atlantic Coast was transported in tankships. When 50 of these vessels were suddenly transferred to the British service, the oil industry faced a big problem. One of its answers is an $8,500,000 crude-oil pipe line, extending 236 miles between Portland, Me., and Montreal, Canada, which will have a carrying capacity of 50,000 barrels per day. The longer dotted line on the map is the 1,000-mile route now followed by tankers. The new line will eliminate this run and free at least four tankers for service elsewhere. Two experienced contracting firms, employing 1,700 men, are now engaged in constructing the pipe line of which 164 miles will be in the United States and 72 miles in Canada. The picture just above shows a section of the line being welded preparatory to testing it and lowering it into the trench.

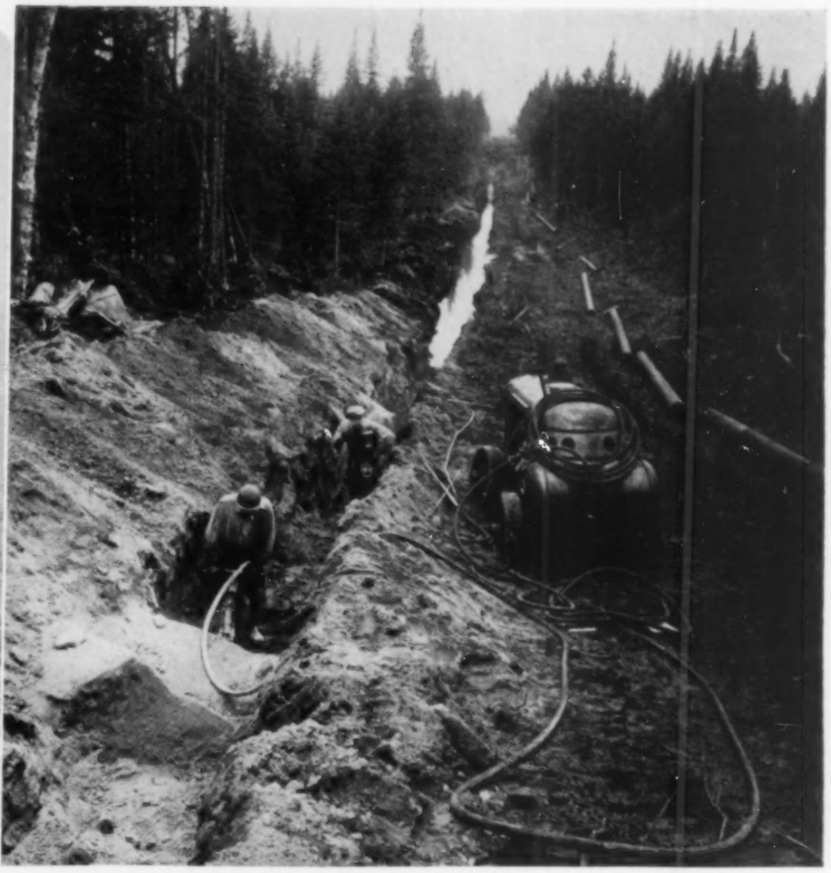
THERE is now nearing completion in the heart of the Green and White mountains of New England and beyond the border in southern Quebec a crude-oil pipe line that stands unique among the world's oil lines. Extending from Portland, Me., in the United States, to Montreal, it has the distinction of being the first of its kind to be constructed between two major seaports. Tankers now bringing oil from South American ports in Venezuela and Colombia will soon be able to unload their cargoes destined for eastern Canada at a new pier in Portland. This will shorten the round trip by 2,000 miles, or by from ten to twelve days, and will release at least four tankers so urgently needed for service elsewhere. Furthermore, as Portland is virtually an ice-free harbor and has a short, straight, and deep channel to the open sea, Montreal will be assured a supply of oil even during those months of the year when the St. Lawrence River is icebound.

When completed, the 236-mile line will handle up to 50,000 barrels of crude oil a day. Eight pumping stations, spaced about 30 miles apart, will force oil through at a maximum speed of 3½ miles per hour. The oil will be about three days *en route*. Starting at sea level in Portland, the line passes through the heart of New England's mountain resort section where it climbs successively higher notches, skirts lake shores, and crosses many valleys and streams. Just below the international boundary, near Newport, Vt., the highest elevation of 1,950 feet is reached. The rough terrain continues for a number of miles in Canada, but the last half of the stretch between the border and Montreal is fairly level going. At the southern bank of the St. Lawrence the line diverges into two extra-heavy 10-inch pipes that are being buried in the river bottom. Other characteristics add interest to the project; but to the construction fraternity none is of more concern than the nature of the ground to be traversed.

Some of the world's fastest-working pipe-laying crews are developed in the southwestern oil fields of the United States. Operating in "home" territory they move with military precision across prairies, swamps, and, occasionally, limestone areas. Transplanting these gangs and their equipment to new country, and adapting their methods to entirely different conditions, was in itself something of an undertaking. But to get the customary results along a course strewn with boulders and consisting, in addition, of more

N. Y. Daily News Photo





N. Y. Daily News Photo

DIFFERENT DIGGING METHODS

Conventional ditching machines excavate the trench in ordinary ground. The picture at the upper left shows one of these units, its buckets feeding spoil on to a lateral belt conveyor that deposits it in a mound alongside. Much of the line, however, passes through rock, which must be drilled and blasted. Scores of Jackhamers and more than 30 portable compressors are used for this work, being concentrated in sufficient numbers to keep the operations moving at the scheduled rate of construction.

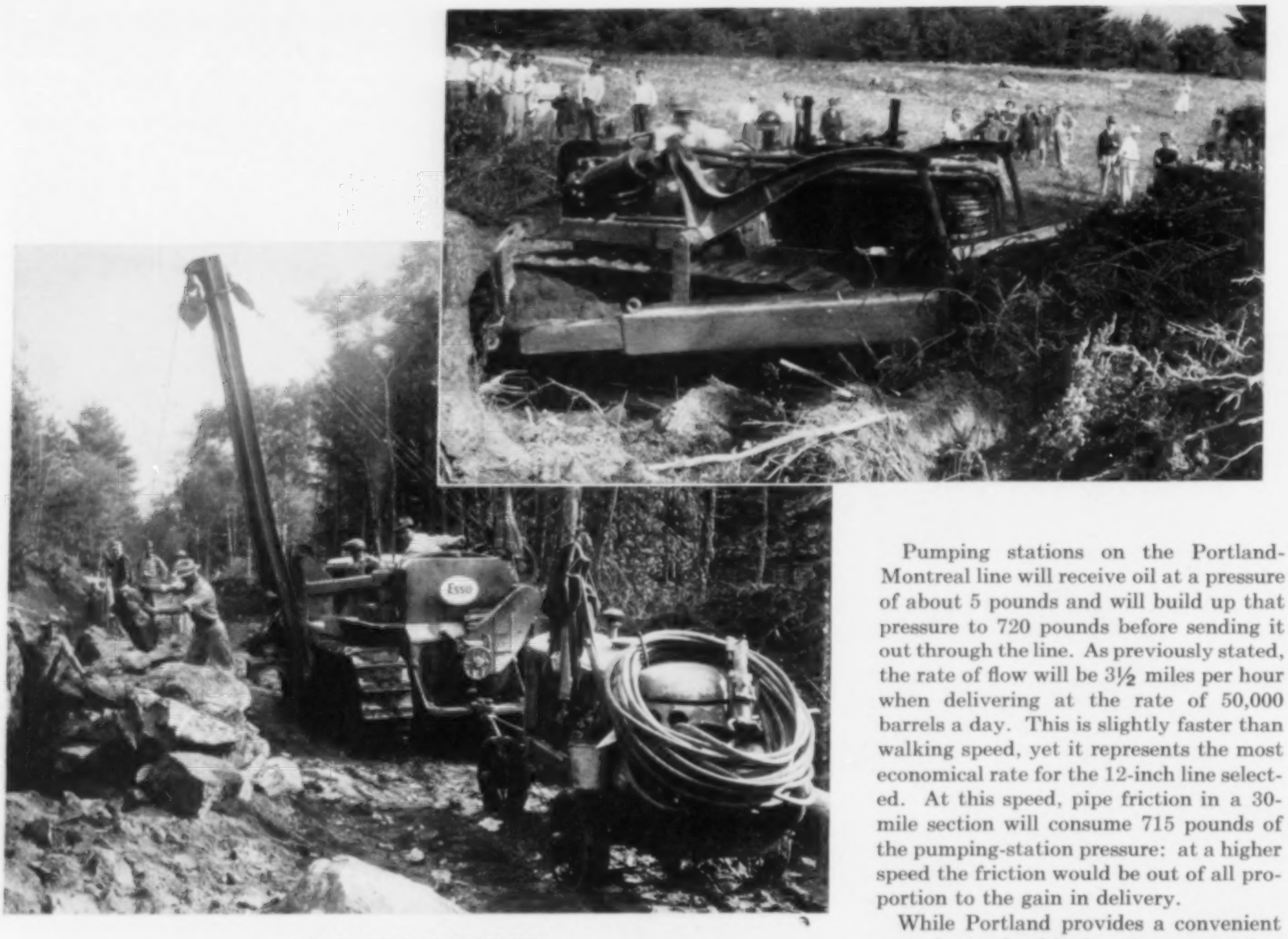
than 15 per cent metamorphic rock, that is an achievement, and it is now coming to a close in the valleys and rocky ridges of New England.

Veteran pipe-line builders were recruited for the project primarily from Texas, Louisiana, and Oklahoma. To many of the skilled equipment operators, as well as to the spread superintendents and job foremen, work far from home is no novelty. A surprising number of them has helped construct lines in South America, Central Europe, and Near East oil-field centers; but none has helped to lay a pipe line in harder rock and in so continuous a rocky region. These southwesterners, deeply tanned, and fresh from work in open country, are frankly amazed and delighted with the tidy green farms and thick growths of unfamiliar trees and bushes that clothe the rugged hillsides and valleys of New England. They are curious, too, about Yankee customs and speech, and apprehensive at the mention of 10-foot snowdrifts and frost penetrating the ground to depths of from 4 to 5 feet.

Supplementing the experienced pipe-laying hands are many local men. Quick to appreciate the orderly speed of the newcomers, and imbued with the spirit of confidence and pride in achievement, many of the former are making plans to accompany the contractors to new locations. Not unlike the casual recruiting of a circus troupe is this picking up of new hands. One foreman claims that, on an average, one out of every three local men his company has hired on jobs away from home showed up for work on the next project!

Calling for a total expenditure of $8,500,000, the system includes a 35-foot right of way, the pier and dockside tank facilities, pumps to send the oil underneath South Portland in an oversize line, a tank farm capable of storing from six to eight of the largest tankerloads of oil, and the eight pumping stations with storage tanks. The line will underpass 45 highways and railroads and cross eighteen streams, the more important ones being the Connecticut, the Richelieu, and the St. Lawrence rivers.

The initial route was selected on the basis of United States and Canadian geological survey maps. But to establish a more exact right of way for the section in the United States, an aerial survey was made of that part of the line. Photographs, taken from a plane flying at an altitude of 17,000 feet, were pieced together to show a 2-mile strip, and on this the exact route was then traced. The right of way determined in this manner was altered only slightly by field surveyors when staking out the line. Restrictions on nonmilitary flights in Canada forbade this



VERSATILE MACHINES

Following the axmen, who cut down the larger trees, come the tractor-powered bulldozers that mow down sizable trees and push aside huge boulders with an ease that fascinates the wayside crowds. Similar machines fitted with side booms help out in various ways. The one shown immediately above is hoisting large rocks out of the trench. It has a portable compressor in tow.

practice in the case of the last third of the route, so conventional survey methods were followed there.

With the course selected, easements covering the 35-foot right of way were secured by oil-company representatives working with local real-estate agents. Little legal difficulty was encountered in this respect, as most of the property owners were delighted both with the unexpected cash reimbursements and at the opportunity of helping in a vital defense project. Unlike a highway or a railroad, it is always possible with a pipe line to avoid existing buildings and to cultivate the fields beneath which it passes.

Like most engineering works, an oil pipe line involves many economic considerations such as cost of installation, cost of power for pumping, size of pipe, etc., and therefore represents a carefully worked-out compromise. Determining the quantity of oil to be delivered at full capacity is, in itself, a big job of estimating and forecasting. In the case of the Portland-Montreal line, the figure established for peak operation is 50,000 barrels a day. This can be counted upon only during the summer months, for when the oil is cold there is increased friction and that will reduce the capacity of the line in midwinter by as much as one-half.

In determining the size and wall thickness it is necessary to weigh the low friction losses of oversize pipe against the cost of such pipe and that of handling and laying it. For a given size of pipe, extra wall thickness permits higher operating pressures and, consequently, a faster rate of flow than would otherwise be the case. Pipe-line engineers, however, can quickly prove that the cost of higher-pressure equipment, including that of operating higher-pressure pumps, far exceeds the advantages of increased flow through the line. An alternative would be to double or triple the number of pumping stations, with correspondingly shorter distances between them. This would obviously multiply the initial investment and operating expenses; but it can always be done to speed up delivery through an existing line without the need of exerting undue pressure at any one point.

Pumping stations on the Portland-Montreal line will receive oil at a pressure of about 5 pounds and will build up that pressure to 720 pounds before sending it out through the line. As previously stated, the rate of flow will be 3½ miles per hour when delivering at the rate of 50,000 barrels a day. This is slightly faster than walking speed, yet it represents the most economical rate for the 12-inch line selected. At this speed, pipe friction in a 30-mile section will consume 715 pounds of the pumping-station pressure: at a higher speed the friction would be out of all proportion to the gain in delivery.

While Portland provides a convenient port of entry for shipping, the construction of the 920-foot finger pier and of the two storage tanks on the South Portland waterfront could not be started until certain shore and river bottom improvements had been made. The location selected has not been developed in the past because of a steep bluff near the water's edge. It was previously the site of a small fishing dock that was abandoned because so many of the operators of small fishing boats had been attracted to other industries, particularly to the new shipbuilding yard on the adjoining property to the east. The ship berths, one on each side of the pier, necessitate the removal of a long rock ledge to a point about 500 feet offshore, as well as some additional river dredging to maintain the 37-foot minimum depth (mean low water) of the harbor proper.

The new pier will be a conventional steel-and-concrete structure. It will accommodate two of the largest tankers of the 20,000-ton class. These carry a cargo of from 140,000 to 150,000 barrels and will discharge with their own pumps directly into the storage tanks now being built on the 6-acre property constituting the pier site. Depending on the size of the vessel, from eight to twenty hours will be required to unload a tanker. Each of the two terminal storage tanks has a capacity of 140,000 barrels and is surrounded by an earthen fire wall. The main storage facilities are situated about 2½ miles from the waterfront and are connected to those on the pier by a heavily coated 24-inch pipe. The protective layer consists of ½ inch of hot asphalt and felt and is needed to prevent corrosion in the salt-water impregnated soil of the South Portland area. Four 100-hp. pumps at the pier will send the oil through the city line to the 34-acre tank farm where four 140,000-barrel tanks are being installed. These, too, will be surrounded by earthen fire walls. All storage tanks in the Portland area are of the floating-roof type. They are 144 feet in diameter and 48 feet high.

The 12-inch line to Montreal starts at the tank farm where the first of the eight pumping stations is under construction. Each will house two 500-hp. pumps—those in the six stations in the United States will be electric-motor-driven units while those in the two Canadian stations will be diesel-engine driven. From a manifold station, located at Boucherville on the south side of the St. Lawrence, all the incoming oil will be delivered to various oil-company properties along the opposite bank through either one of the two 10-inch pipes being laid under the river. The use of twin heavy-duty lines (the 10-inch pipe has a wall thickness of ½ inch) is a protective measure, for this section of the system could not be by-passed in an emergency with a temporary surface line because it would interfere with shipping. In fact, the entire system is designed for flexible operation. In the event of a shutdown of any one of the pumping stations, the flow of oil would be diverted at that point, thus possibly reducing but not halting it. The storage tanks at each station will provide several hours' pumping reserve.

The trench in the river bed for the St. Lawrence crossing was excavated partly in soft material and partly in underlying trap rock and shale. The former was cleaned out by means of a hydraulic dredge, following which a steam-driven submarine drill boat put down holes in the rock along the trench line. After blasting, a ladder dredge served to remove the broken material down to the bottom of the trench line. The pipes are being laid 45 feet below mean low water and 5 to 10 feet under the river bed. This is sufficient to avoid relocating them in the event the present 35-foot channel is deepened to permit the passage of the largest ocean-going vessels. In most of the other rivers and streams in the path of the right of way, the pipe is placed in shallow trenches and weighted so as to withstand the force of the current should any section become exposed. However, in the case of the swift Richelieu in Canada, a deeper trench had to be excavated in the rock that forms the river bottom at the crossing.

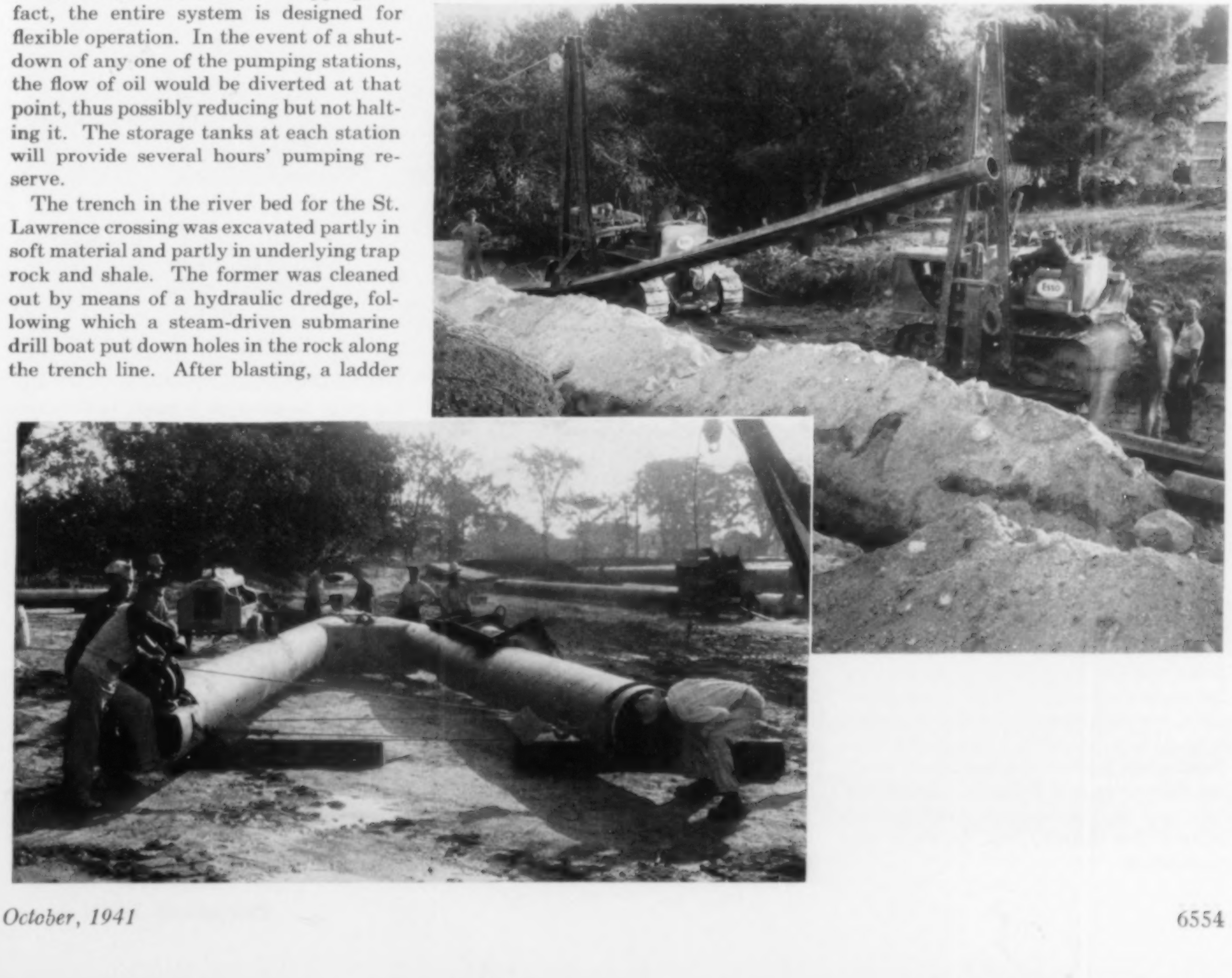
All submerged pipe is first cleaned with wire brushes, given a new primer coat, covered with Ennjay enamel, and is then wrapped with asphalt-impregnated felt. Similarly protected pipe is used in congested areas and for a short distance in Canada where the line cuts through peat bogs. All told, less than 2 per cent of the 236 miles of piping passes through formations that necessitate coating it.

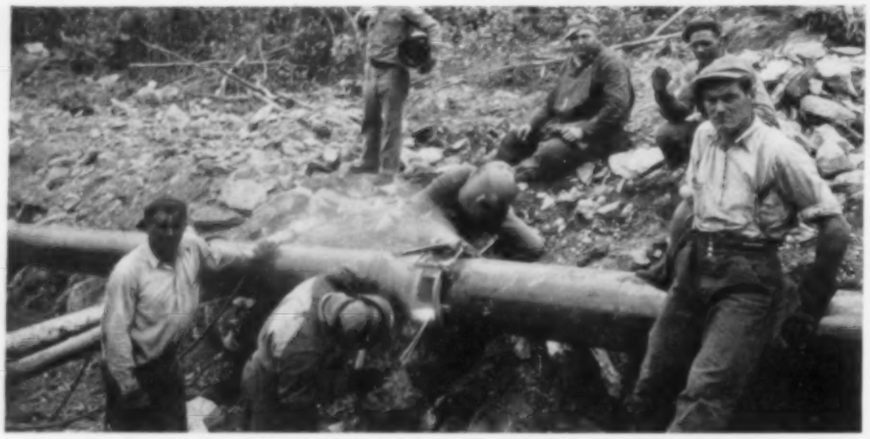
When the right of way has been obtained and the line staked out, a crew of men clears a path for the construction and supply units which follow. This, of course, is a continuous procedure, for the final arrangements before work in any section can be started must be made well in advance of actual operations. But on one occasion, when work was just beginning, an advance gang was drawn up alongside property that was to be crossed waiting for the last signature that would permit it to proceed. Before the ink was dry on the lease, the roar of the tractors signaled the advance of the project.

Axmen in the clearing crew cut down only the larger trees in those stretches

BENDING PIPE

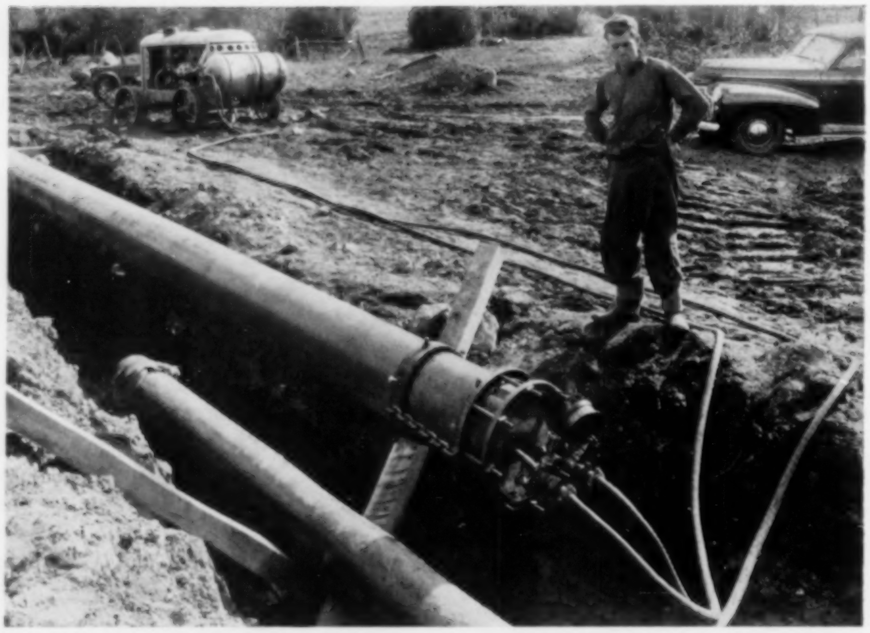
All pipe is delivered in straight lengths and is bent on the job as required. The lower view shows the rigging used to make a reverse bend in a section of 24-inch pipe that is run underneath South Portland. The structure resting on the pipe at the right is a Johnson torch that heats the bending point by means of an oxy-acetylene flame. Pull exerted by the winch-powered cable in the foreground bends the section as desired. Air for the flame is supplied by the portable compressor in the background. Out on the main line, where 12-inch pipe is employed, bends are made without heating. The side-boom tractor at the left in the picture immediately below is fitted with a bending shoe for holding down the pipe at the point where the bend is to come, while the right-hand tractor pulls up on the pipe with a cable powered by a hoist.





WELDING AND TESTING

After the trench is dug, 40-foot lengths of pipe previously strung out along the route are assembled for welding. An alignment clamp (left) holds abutting beveled ends together while they are joined by an initial tack and bead. The crew doing this must keep ahead of five to seven others, which finish the job by applying four more laps or beads. The line is given its initial test in assembled sections of 4,000 to 12,000 feet. The ends are capped and compressed air from a portable compressor is fed in at one end (below). When the line has been put under 100 pounds pressure, each joint is swabbed with a soap solution and inspected for leaks. After all the pipe has been laid, it will be tested under 800 pounds hydrostatic pressure.



where there is a solid footing for the bulldozers following right behind them. Saplings are scraped off, and even trees with 6-inch trunks are uprooted by the blades of the powerful 15- and 16-ton crawler-type bulldozers which smooth up the path and push aside boulders and fallen trees. The sight of a pair of these monsters rolling away a rock as big as a sedan is a fascinating spectacle, and crowds of people frequently gather to watch and even applaud when a bulldozer wins an argument with a particularly stubborn boulder or tree. In swamps the axmen do almost the whole job, even to trimming and laying the countless small trees to form a corduroy road over which construction equipment can travel.

The trench gang comes next. In open sections where the ground is free of rocks or big roots, a digging machine cuts a precise trench 2½ feet wide and about 4 feet deep, piling the earth in a neat row alongside. Sometimes fields that promise easy going for the digging machine prove to be disappointingly full of boulders. These have been deposited in ages past, and must be removed by rooters, powerdiggers, or, if too large, by drilling and blasting. Where ledge rock is encountered, portable compressors and drills are brought up and the trench is blasted. A back hoe, which resembles a power shovel operating in reverse, clears out the shattered material to the required depth. The back hoe is also used in swamps thick with tree roots, and in digging the trench in the beds of small streams.

Because the job involved so much rock work, portable compressors, paving breakers, and Jackhamers formed an integral part of the trench-excavating equipment in nearly every section of the line. Some 30 Ingersoll-Rand 2-stage air-cooled units, many of them new models with automatic fuel-saving speed regulators, are being used by the several pipe-laying crews. A Class GK-105 portable unit and JB-5 Jackhamers is a combination found many times over on the project. Detachable rock bits with a 4-point center hole are utilized throughout, I-R Jackbits predominating.

While excavating is in progress, pipe is brought up by trailer-trucks which string it along the right of way. It comes in 40-foot random lengths and weighs 49.56 pounds per foot. Six of these units make a good load. As the combined trailer-truck is some 50 feet in length, it would be difficult to maneuver it either on the right of way or in narrow access roads. To overcome this, an extra tractor is used, as follows: The latter waits near an access road for a loaded trailer-truck, and then backs up against the trailer. When all the pipe has been unloaded, the front tractor is detached and the rear power unit hauls the trailer away to the rail depot for a new load. The remaining tractor then slowly backs up to the access road where it turns around and waits for the next lot of pipe.

Side-boom tractors now pick up the pipe and place it on logs or timbers which straddle the trench. These same tractors are responsible for making the spectacular cold bends in pipe that are occasionally required to follow an offset in the trench, but more often to conform to the contours of the terrain. Two side-boom tractors are usually used, one to hold the pipe down at the point where the bend is desired and the second to pull up one end of it. A single tractor can do the job by climbing on top of the pipe and hooking a line from its hoist to either end, but a pair can work faster and with greater accuracy. In bending pipe, no attempt is made to do more than approximate the curvature of the ground; and the final tie-in is made by cutting off as much of the pipe as necessary with an acetylene torch and giving the end a beveled edge.

With the pipe over the trench, the beveled ends are cleaned with wire brushes preparatory to welding. A typical "spread" or pipe-laying crew will have from five to seven welders, each with his helper and a portable arc welder. Each master welder is accountable for his own welds, and he stamps them with an identifying mark. When a defective weld is discovered in testing, the man who made it gets a "black mark." Needless to say, the quality of the work is exceptional.

When the pipe ends have been brought together, an alignment clamp is placed around the joint and a tacking or stringer bead is started. A few spots hold the pipe together, and the fixture is taken off and put on the next joint. The stringer-bead welder finishes one lap and moves ahead. Next the main welding crews take over. Four more complete laps, or a total of five, are required to fill the V-shaped joint formed by the beveled ends of the ⅜-inch-thick pipe generally used for the Portland-Montreal line. Most 12-inch lines are made up of pipe ¼ inch thick and need only three beads to tie them together.

Before being lowered in the trench, sections ranging from 4,000 to 12,000 feet in length are given an initial test. For this purpose a cap is fitted over each end and air from a portable compressor is fed into the pipe through a fitting at one end. Several hours are required to bring the pressure up to the desired 100 pounds, and when that point is reached each joint in turn is swabbed with a soap solution. As soon as applied, even the minutest leak will be revealed by tell-tale bubbles.

While this test is being carried out, a go-devil or scraper, also nicknamed "the pig," is pushed through the line under the pressure of compressed air. The scraper resembles a huge spool with a series of trailing knives which thoroughly scrape the inside wall of the pipe while the forward disk pushes any debris ahead of it. In addition to dirt, stones, leaves, etc., which get into the line during construction, the scraper often comes out with a surprising collection of small birds, animals, and reptiles which have crawled in at some time or other. When tested and cleaned, the section is welded to the pipe already in position, is dropped into the trench, and covered over by means of bulldozers which shove the material back into the excavation in short order. Final testing will be done under hydrostatic pressure after the entire line has been placed. The water will be introduced at a pressure of 800 pounds, and will ultimately be displaced by the oil when it is pumped through the system. When in service, the line will be inspected daily by airplane. Present experience in the Southwest has proved that pipe lines can be inspected just as efficiently and at considerably less cost from aloft than by walkers.

Some speculation has centered about the winter operation of the system. At present, no provision is being made for heating the oil, because it is planned to send through it oils of low viscosity and low pour point for cold-weather pumping. Furthermore, the oil will reach Portland at relatively high temperatures. Starting from South American ports, the tankers will follow the warm Gulf Stream which flows within 100 miles of Portland, so that the run in the cold waters coming down the coast from the Arctic will be relatively short. Crude oil reaching Portland by tanker will pass through the United States under bond—because all of it is destined for Canada and special provision has been made to waive existing import-export restrictions.

The project, known to the public as the Esso Pipe Line, is being carried out under the supervision of the newly formed subsidiaries of the Standard Oil Company (New Jersey)—the Portland Pipe Line Company, which is in charge of the work in the United States, and the Montreal Pipe Line Company, Limited, which is directing the Canadian operations. All contracts were let in May, and actual construction was underway before the end of June. The Oklahoma Contracting Company (Thomas R. Jones) of Dallas, Tex., was awarded the stretch from Portland to Gorham, N. H., including the 24-inch section through South Portland. Williams Brothers Corporation of Tulsa, Okla., received contracts for the line from Gorham to Montreal and for the building of the eight pumping stations.

The work of the Oklahoma Contracting Company is in charge of T. A. Hester, vice-president: that of the Williams Brothers Corporation is being directed by D.R. Williams, vice-president. H.L. Davis is general superintendent and G.S. Connors is supervisor. H.M. Steveson, chief engineer of the Portland Pipe Line Company, is in charge of all engineering and construction operations, with G.H. Lee as assistant chief engineer. A.H. Chapman is project engineer for the Portland terminal.

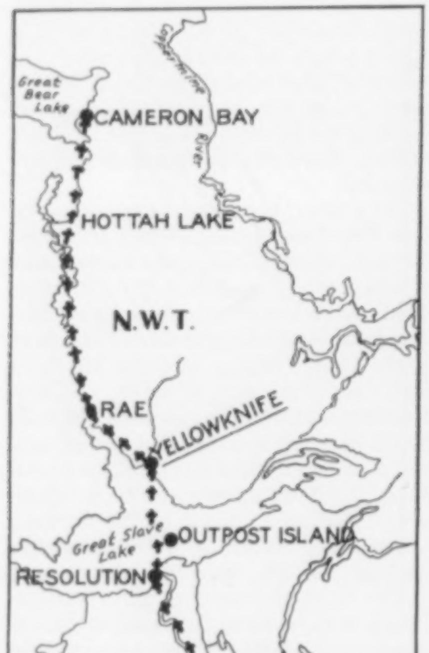
A BIT SHOP MOVES

The Oklahoma Contracting Company is using Jackbits for all rock-drilling work and reconditioning them in a shop containing Ingersoll-Rand equipment, including a Jackmill, a Jackfurnace, and a quenching tank with controlled water flow for hardening bits with factory precision. The Jackfurnace is supplied with air by an I-R D-85 portable compressor. The shop was originally set up at Gorham, N.H., but when the halfway mark was reached it was transferred to a location near Portland. One of the pictures shows the equipment being loaded aboard a truck that moved it in short order. The other is of the shop as it was established near Portland.

Yellowknife—

Canada's Northmost Gold Camp

E. L. Chicanot



THE ROUTE TO YELLOWKNIFE

Showing the air, rail, and water lines leading to the northern mining areas. It is 710 miles by air from Edmonton to Yellowknife. The radium mines of Eldorado Gold Mines, Ltd., are at Cameron Bay, Great Bear Lake, about 250 miles north of Yellowknife.

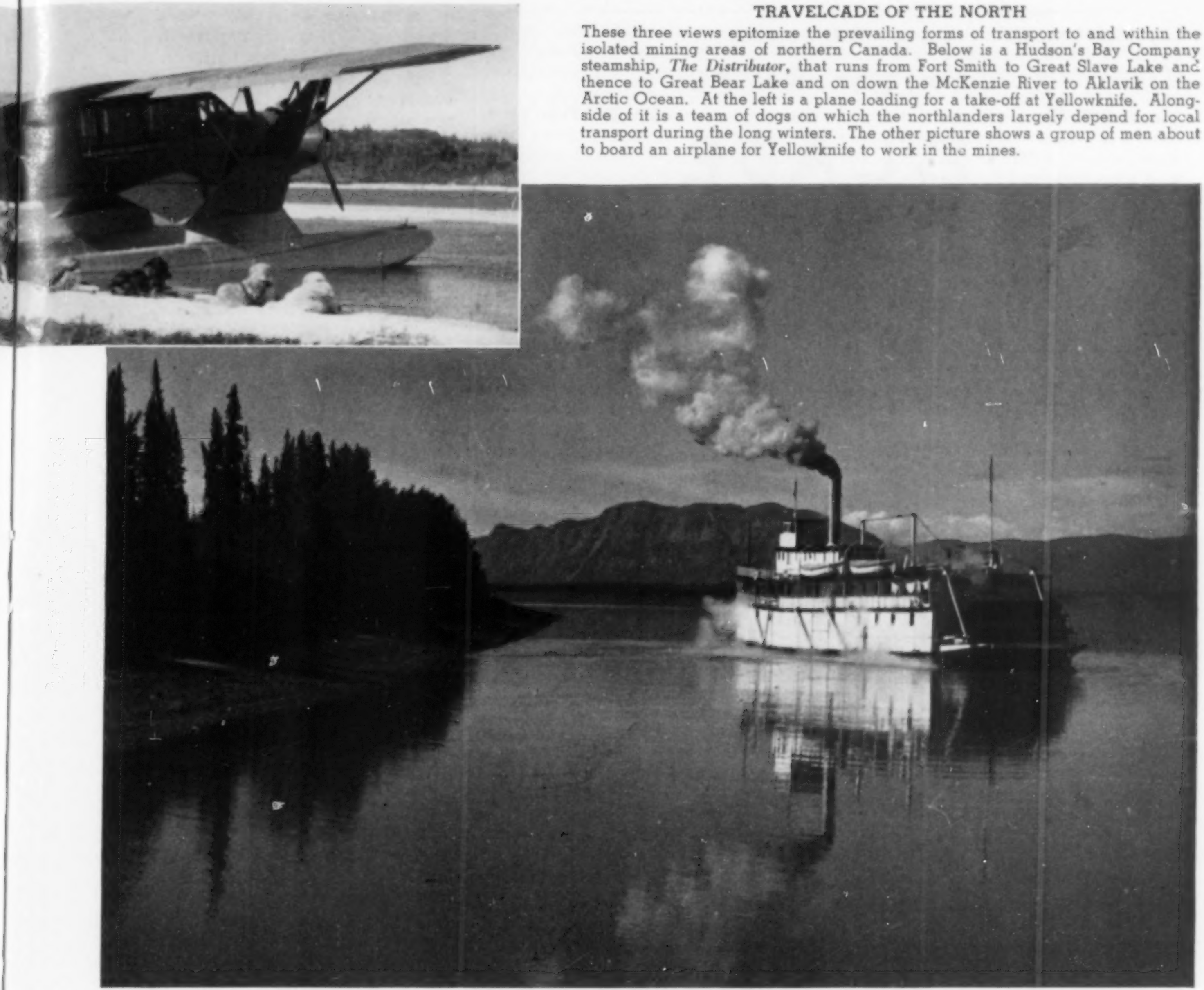
THE name Yellowknife already has a profound significance in mining and allied circles. In the future it may come to be as familiar as Klondike or Transvaal, for conservative authorities believe that this newest of Canada's mining fields may well develop into its greatest. The entire history of Yellowknife is confined to the last decade; and the evolution of this field is possibly the greatest achievement of the airplane as a factor in the mining industry.

While vigorous prospecting was taking place in well-nigh all other sections of the Dominion, the Northwest Territories, one of the most promising of areas, remained neglected. There were many reasons for this. Miners from the adjacent Yukon, who had gone through the '98 boom, were interested only in placer mining. In Alberta, to the south, attention was concentrated on other matters, principally oil. Most influential of all, however, was the problem of distance from modern centers of industrial development, which rendered prospecting expensive and tedious. Not until the airplane proved that it was feasible of operating in the wilderness places and allied itself with the workers there did the Northwest Territories begin to come into its own as a mineral field.

Following the success of Canada's pioneer commercial air service in opening up and promoting the progress of the Rouyn copper-gold field in Quebec, the airplane, sponsored by important interests, went prospecting in the Northwest Territories in 1928 and 1929. Two aerial companies were engaged in the search for rumored rich placer deposits and for a fabled copper area. In 1931, aerial transportation made possible the discovery of silver-radium ore on Great Bear Lake, signaling the opening of the Northwest Territories' era of mining, into which it has now well entered.

The first gold discovery in the Great Slave Lake region was made in 1933 by a prospector who, with a single companion, journeyed down the Yellowknife River from the headwaters. Another find was made in 1934, though little work was done. Then in 1935 the government Geological Survey made a significant discovery and passed the news on to prospectors. A rush developed, which resulted in the staking of a large area of ground in Yellowknife Bay. Numerous other finds were made, big interests were attracted, and the boom was on.

Developments since that time can be summed up briefly. In 1937 the Con Mine of the Consolidated Mining & Smelting Company made preparations for production, which began in 1938. In 1939 the adjoining Negus Mine became a producer. Today six mines in the field are yielding gold—Con, Negus, Slave Lake Gold Mines, Ptarmigan, Thompson-Lundmark, and Mercury. So far they have accounted for more than $6,000,000 worth of the precious metal, although they are just getting into their stride. And, most significant fact of all, these half dozen mines are scattered throughout an area of at least 15,000 square miles in which favor-



TRAVELCADE OF THE NORTH

These three views epitomize the prevailing forms of transport to and within the isolated mining areas of northern Canada. Below is a Hudson's Bay Company steamship, *The Distributor*, that runs from Fort Smith to Great Slave Lake and thence to Great Bear Lake and on down the McKenzie River to Aklavik on the Arctic Ocean. At the left is a plane loading for a take-off at Yellowknife. Alongside of it is a team of dogs on which the northlanders largely depend for local transport during the long winters. The other picture shows a group of men about to board an airplane for Yellowknife to work in the mines.

able indications of mineralization are found. Hence the suggested possibility of a future greatness for this camp.

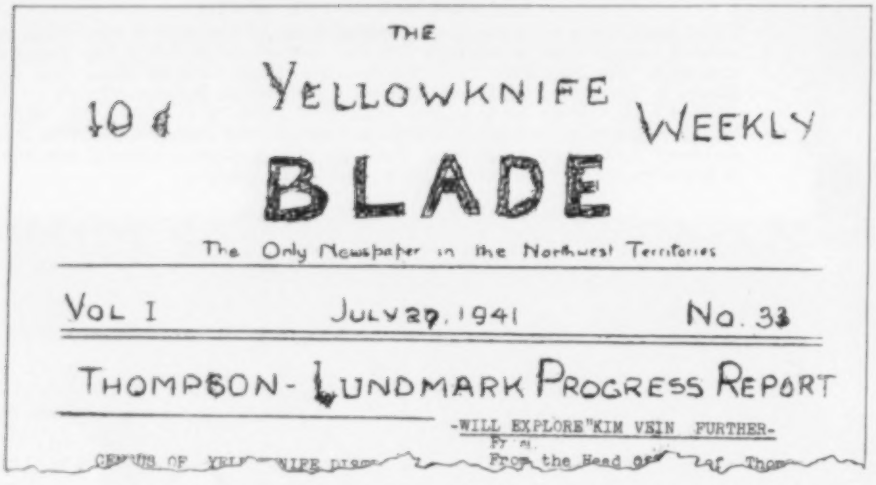
The story and prospects of Yellowknife, to one who has known other mining fields of Canada in their early days, are sufficiently intriguing to make one want to visit it for purposes of comparison. A glance at the map, however, is apt to dampen one's enthusiasm. The field seems to lie there in absolute isolation, surrounded by a depressing area of lake-dotted tundra, only 200 miles or so from the Arctic Circle. It is 800 miles from Edmonton, and about 650 miles from the nearest point of railway contact. Reaching it within reasonable limits of time and expense seems impossible at first glance, for the map belies the simplicity of the situation.

The Northwest Territories possesses a splendid and efficient natural travelway in a river system extending from Fort McMurray, 260 miles from Edmonton, to the Arctic ocean. Transportation is possible over this entire distance of 1,661 miles save for a single 15-mile portage where there is motor conveyance. This route was discovered by the early explorers, and was used for more than a century by traders, trappers, and missionaries.

At Fort McMurray, stern-wheel steamers and barges load for their trip through the mining field and to more than a dozen posts along the way. The route leads down the Athabasca River to Lake Athabasca; out of this on to the Slave River to Great Slave Lake; and thence to the majestic Mackenzie River. The complete journey ordinarily requires sixteen days, with stops made nearly every day at the various posts to discharge cargo. It is a superb trip, especially for the jaded and neurotic, but to the average business man, with whom time counts, the airplane makes greater appeal as a means of getting into the mining region.

In this section of the Northwest Territories the plane seems to have reached its apogee of service. From Edmonton there is a 3-day-a-week schedule of flights into Yellowknife, the line carrying not only mail for intervening points, trading posts, and developing mines but also package freight and passengers. Comfortable twin-engined machines of American manufacture are used. They have a crew of two and are capable of carrying eight persons in additon to their freight.

It is a journey of approximately eight hours from Edmonton, the capital of Alberta, to the Town of Yellowknife on Great Slave Lake, and even to those accustomed to traveling by air it offers something in the way of novelty. The most striking impression is the blasé way in which northerners regard air transport. While the newcomer, observing the plane loaded up with miscellaneous freight in addition to its human cargo, is not entirely free from apprehension and is certainly intensely interested in all about him, the mining man, going to his work or bound



THE

10¢ YELLOWKNIFE WEEKLY

BLADE

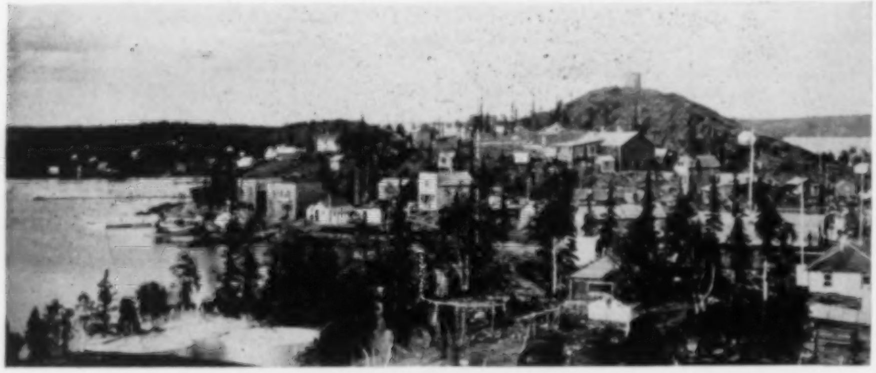
The Only Newspaper in the Northwest Territories

VOL I JULY 27, 1941 NO. 33

THOMPSON-LUNDMARK PROGRESS REPORT

-WILL EXPLORE "KIM VEIN FURTHER-

From the Head



YELLOWKNIFE AND ITS NEWSPAPER

Occupying rocky ground on the north shore of Great Slave Lake, Yellowknife has a population of 1,300 within a radius of 3½ miles of the post office. It boasts the only newspaper in the Northwest Territories, a mimeographed weekly that sells for $4 a year.

for a spell "outside," proceeds, after a few minutes of polite conversation, to put his chair in the reclining position and goes to sleep or becomes absorbed in vicarious adventuring through the medium of a pulp magazine.

Not long after leaving Edmonton the end of the patchwork of agricultural settlements is passed and one is flying over typical North Country, which will persist until the destination is reached. It is a dense carpet of spruce and other timber plentifully spattered with innumerable lakes of all sizes and through which runs a wide ribbon of silver—the river, the arterial avenue and the pilot's guide. In the summer months numerous forest fires will probably be seen, and at times the plane goes through almost impenetrable smoke. Stops are made at Fort McMurray and Fort Smith to drop off mail and freight, but principally for refueling. During those brief interludes, the visitor strolls about in a balmy atmosphere, observing the lush vegetation on every hand and the beautiful gardens.

The writer, who thought he knew something about the North Country, and who took counsel of others he considered more experienced, was woefully misled as to summer temperatures. He packed into his bag heavy underwear, top boots, and a heavy sweater. In the plane he discarded his jacket and never replaced it until his return to Edmonton. The boots and the underwear were superfluous baggage throughout the trip, and the sweater was put on only once in Yellowknife as a concession to a slight coolness when, about midnight, he watched the final disappearance of the sun. There were many revelations about this excursion to the Northwest Territories; but the greatest of them was possibly the glory of the summer days, the balmy invigorating air in which it was sheer joy to bask without discomfort from either heat or cold.

Upon first appraisal, Yellowknife resembles many other mining camps in the Canadian North when they were in their pioneer stages. The town tumbles over a rocky pile on a point running out into the lake and forming a well-sheltered bay; and it does not take long to complete a survey by sauntering around that landlocked body of water. The community has two big general stores and several small ones, including drugstores, constructed for the main part of worked lumber. There are three or four cafés, a bank, a movie theater where shows are given twice a week, and, of course, the Hudson's Bay trading post and the mounted-police barracks. The Northwest Territories' only newspaper is produced weekly in Yellowknife on a mimeograph machine. The homes, which run in a line around the rocky point facing the water, are of every order. Some might grace a metropolitan suburb, many are built of logs, and there are clapboarded shanties. Others have wooden foundations and tent upperstructures, and a number are just plain tents.

Yellowknife, with a population of 1,300 within 3½ miles of the post office, is locally governed by a board of five trustees of whom the chairman is a stipendiary magistrate. Two of the trustees are elected and two are appointed annually by the Dominion administration at Ottawa. Their functions are licensing, looking after sanitation, public health in general, and other similar matters. The town has the first government liquor store in the Northwest Territories, where residents are limited to two bottles of hard liquor a day, and a beer parlor which operates 24 hours a day with the exception of Sunday.

Gradually, as the atmosphere of the place seeps in, one senses something subtly different about it compared with other mining camps one has known. Perhaps it is the presence of Indians on every hand, and the teams of husky dogs tied up behind many dwellings. Or it is something suggested by the bales of Arctic fox furs standing outside the air-services office. Again, it may be the sight of a yellow-striped Mounty striding down to his similarly marked canoe. At any rate, the impingement of mining upon the traditional life of the subarctic has given it a peculiar complexion and tone.

The scene surveyed from the water's edge is an attractive one. Around a bend, at a distance of about 3 miles, loom the tall structures of the Con Mine buildings. Bringing the gaze nearer are seen seven huge oil storage tanks over which gulls are ceaselessly swooping. Numerous islands offshore are dotted with little cabin homes where part of Yellowknife's working population dwells in comparative exclusion. The waterfronts are lined with canoes and other river craft. So far there is no sign of the expected hardship and deprivation. It will no doubt be encountered when one comes to replenishing the inner-man.

Bearing in mind the location, just a short distance from the Arctic Circle and cut off by many hundreds of miles from the accustomed forms of transportation, the bill of fare at any of the crude little restaurants is nothing less than amazing. Apparently everything can be had, from all kinds of meats and vegetables to a wide selection of fresh fruits. The one exception seems to be fresh milk—that used throughout the camp coming from a tin. Save for the appointments, the diner might easily be in Montreal or in New York. One leaves the table satisfied; but the meal has cost a good deal more than it would ordinarily.

Until recently, Yellowknife—town and mining camp—ran entirely on gasoline and fuel oil from the Fort Norman wells discovered in 1919-1920. Now there is in operation a hydro-electric station built by the Consolidated interests that is supplying power to most of the mines in the field. The paddle and other manual means of locomotion have disappeared, and every canoe and boat, even those belonging to impoverished Indians, has its outboard motor. All manner of craft are seen putputting in the bay, their owners bent on vague missions, many of them just killing time and covering distance. Indeed, as a film of gray comes over the sky, betokening the brief subarctic night, as groups of gulls swoop around and an occasional fish is seen to jump, it is difficult to believe that this is not a summer resort from which one will be taking a train back to the office tomorrow.

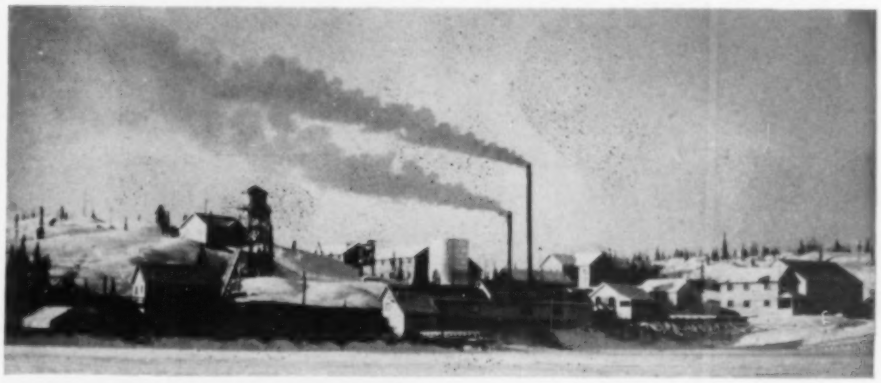
But morning reveals more of the economic side of the picture. The bay is a scene of ceaseless bustle and activity. A miniature steamship towing a barge loaded with heavy machinery chugs past on its way to one of the mines. Water taxis are plying regularly between the town and the mines. At one wharf a barge is under construction, and at another a boatload of Indians from the nearby Indian village is disembarking. A plane setting out on its scheduled flight to Edmonton takes aboard a bale of furs, half a beef for a mine *en route*, and the last gold brick to be refined. On another chartered plane are being loaded a team of seven husky dogs and a canoe, which is strapped to the pontoons as the slim wife of a trapper goes by air to join her husband some hundreds of miles in the barrens. It is pay day at the mines, and the young girl who ferries the short distance between the town and the island on which the liquor store is situated is doing a rushing business. It will be a hectic night in the saloon, with the improbability of much sleep for those in the hotel rooms overhead.

But if Yellowknife has been a revelation, greater surprises await one at the Con Mine. Actual operations are about a mile back from the water; but the village developed there by the Consolidated Mining & Smelting Company stands at the top of the rocky pile which forms the shore. One taxis across just as one of the two planes maintained by the mine for the transport of executives, personnel, and light freight takes off. Brisk activity prevails at the wharf, for a barge has arrived in the course of the morning and a gang of men is busy unloading heavy machinery, lumber, etc.

We move about the village with its magnificent vista of island-dotted water. There one finds comfortable little homes comparable to those in any city suburb, and huge dormitories for single men. We are privileged to visit the apartment house, set up like some medieval edifice upon the cliff-like shore in the crevices of which are brave attempts at gardens. Many of the executives live in the building; and its completely modern facilities—even hot and cold running water—make it hard to realize that one is in the shadow of the Arctic Circle. The doctor takes us through the well-appointed hospital with its staff of two nurses, and we learn something of the splendid arrangements made for the sick at the mine and in the surrounding territory. Nearby are tennis courts and other means of recreation. It is difficult to observe any phase of living that might suggest that these people are suffering by reason of their isolation.

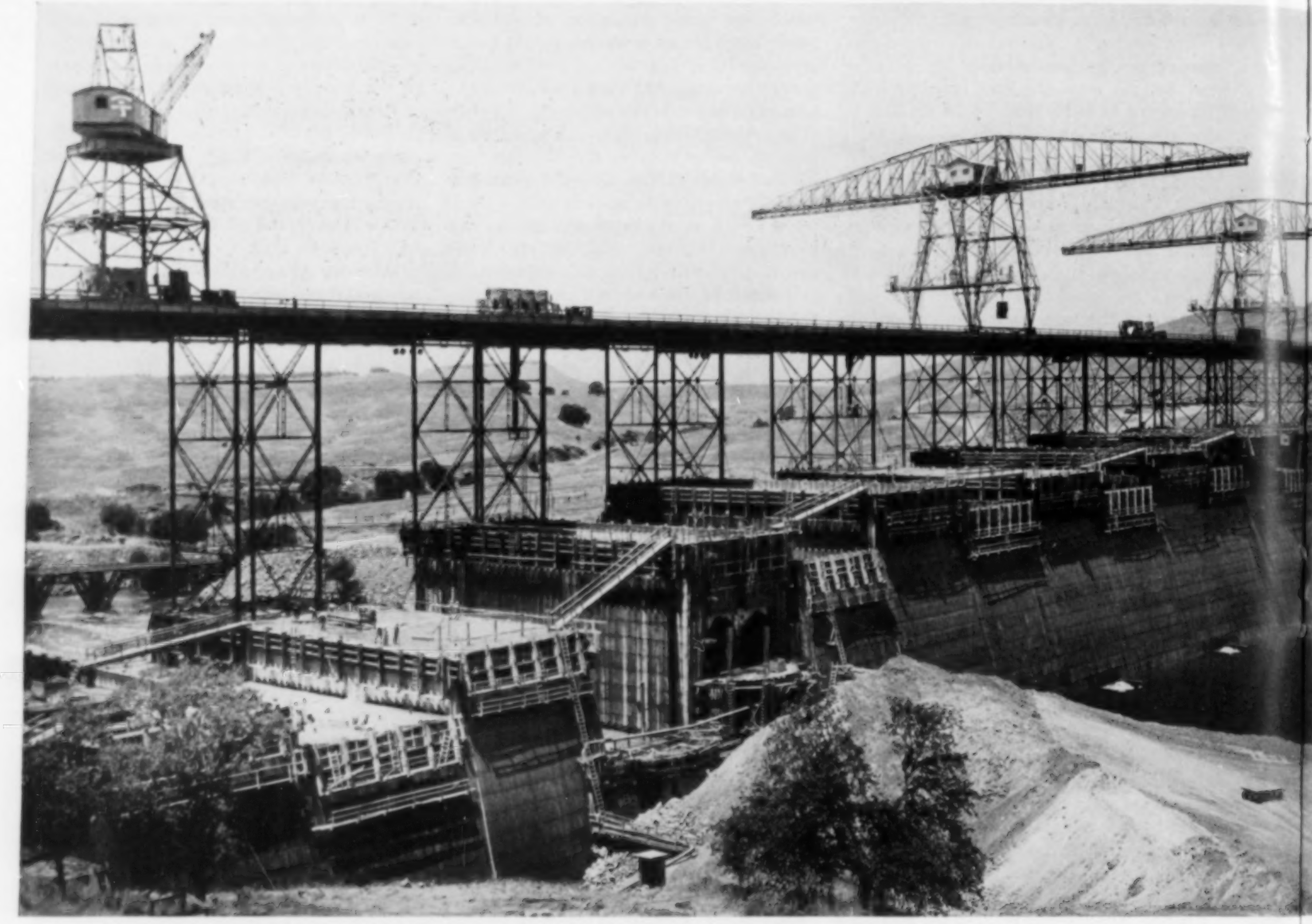
A trip to the huge refrigeration plant on the Con property explains a good deal. It is the source of the fresh vegetables and fruits, the ice cream and other perishables we have been enjoying at Yellowknife. Formerly such wilderness luxuries were brought in by plane and, necessarily, were not so plentiful and cost much more than they do today. Now a refrigerated barge is towed up the riverways from Fort McMurray to Yellowknife each week. Its cargo is unloaded there and kept in cold storage to be distributed, as needed, by boat or plane to the town and the mines. In the big plant were abundant supplies of meats and produce to tide the population over the season when river transportation is closed. There were rows upon rows of cases of eggs that will be consumed in the territory this winter, and turkeys that will be served on Yellowknife's tables on Christmas Day.

Such was the experience everywhere as one wandered about from mine to mine. Everything—the warm soft air, the wild strawberries and raspberries underfoot, distant banks of fireweed suggestive of heather upon a Scottish moor—belied ingrained impressions of the Northwest Territories. Ingenuity and enterprise have overcome what might be considered natural obstacles to development so that Yellowknife, practically within the Arctic, suffers in no respect when compared with similar settlements in more conveniently situated areas.



YELLOWKNIFE GOLD MINES

There are six producing gold mines in the area, and it is expected that their 1941 output will approximate $7,000,000. Two of them, the Con Mine of the Consolidated Mining & Smelting Company (top) and the Slave Lake Gold Mines, on Outpost Island, are shown here. The Consolidated interests have completed a $6,000,000 hydro-electric plant on the Yellowknife River and power from this source has now supplanted diesel power in most of the mines. Five mills for treating ore are in operation and two more are being built. Besides gold, tungsten is being produced, and there are indications that radium, molybdenum, and perhaps other metals may soon be added to the list. More than 6,000 claims have been filed in the area centering around Great Slave Lake; and 65 established companies, some of them prominent operators elsewhere, are carrying on investigations. The general area measures 600x1,000 miles, and a large proportion of it is covered by the pre-Cambrian shield of rocks that has yielded mineral wealth in many other parts of Canada.



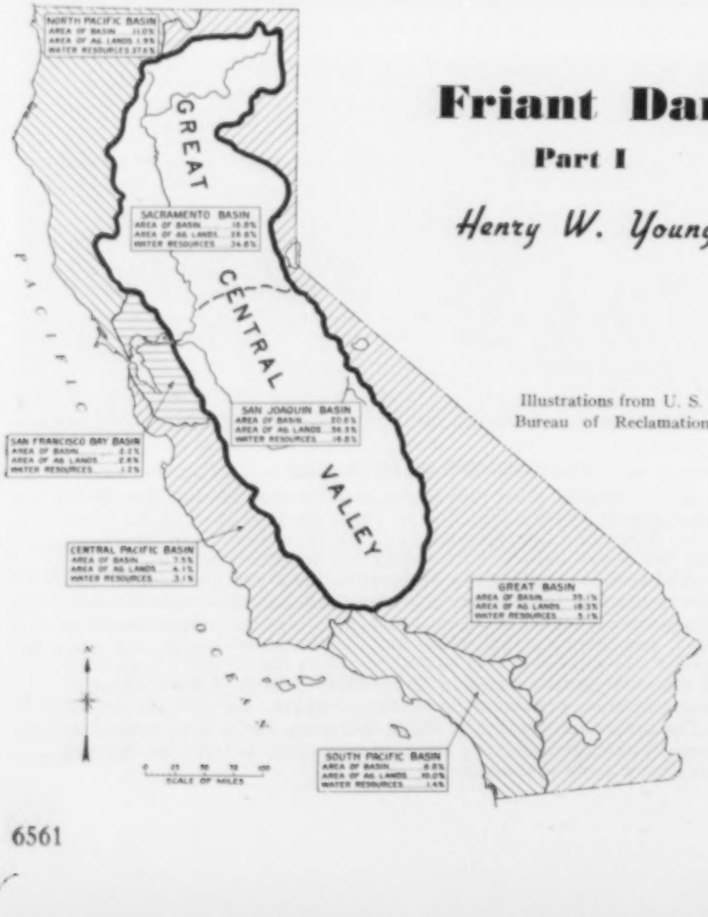
Friant Dam

Part I

Henry W. Young

Illustrations from U. S. Bureau of Reclamation

WHEN a man makes good in an organization in a certain kind of work, and a contingency arises calling for something really big in his line at another point, that man is likely to be promoted. That the same thing can happen to a river may sound fantastic. But that is virtually what the U.S. Bureau of Reclamation is doing in connection with the Central Valley Project in California—promoting a river. It is saying to the San Joaquin which cuts across the valley: "You are doing a nice irrigation job here in your territory, but there is a bigger one in the southern end of the valley that requires a river of your caliber. So we are going to send you down there to tackle the job. Who'll handle your work here? Don't worry about that. We'll get a fellow from up north. He's a little green at this sort of thing but has tremendous


NORTH PACIFIC BASIN
AREA OF BASIN 11.0%
AREA OF AG LANDS 1.9%
WATER RESOURCES 27.6%
GREAT
SACRAMENTO BASIN
AREA OF BASIN 16.8%
AREA OF AG LANDS 26.8%
WATER RESOURCES 34.8%
CENTRAL
PACIFIC
SAN JOAQUIN BASIN
AREA OF BASIN 20.6%
AREA OF AG LANDS 36.3%
WATER RESOURCES 16.8%
SAN FRANCISCO BAY BASIN
AREA OF BASIN 2.2%
AREA OF AG LANDS 2.6%
WATER RESOURCES 1.2%
VALLEY
CENTRAL PACIFIC BASIN
AREA OF BASIN 7.5%
AREA OF AG LANDS 6.1%
WATER RESOURCES 3.1%
GREAT BASIN
AREA OF BASIN 35.1%
AREA OF AG LANDS 18.3%
WATER RESOURCES 5.1%
OCEAN
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0 25 50 75 100
SCALE OF MILES
SOUTH PACIFIC BASIN
AREA OF BASIN 6.8%
AREA OF AG LANDS 10.0%
WATER RESOURCES 1.4%

MAP 1—CALIFORNIA'S WATER PROBLEM

Two-thirds of the state's farmlands, requiring two-thirds of all water used for irrigation, lie in the Great Central Valley. The Sacramento Basin has two-thirds of the water resources of the valley, while the San Joaquin Basin has croplands with two-thirds of the irrigation needs. The Central Valley Project is designed to correct this unbalance. The areas of the basins, the areas of the agricultural lands, and the water resources as given on the map are percentages of the respective figures for the state as a whole.

FRIANT DAM TAKES FORM

The picture of the structure (left) was taken on June 2 when 1,000,000 of the ultimate 2,160,000 cubic yards of concrete had been poured. The dam will be fourth highest and fourth greatest in cubical contents among structures of this kind in the United States. Before the barrier could be rooted in solid material, 1,300,000 cubic yards of earth and rock had to be removed. Fourteen wagon drills and numerous Jackhamers combined to drill the rock, producing busy scenes such as that appearing below. Into the drill holes went charges of dynamite to shatter the quartz-mica-schist formation. At the righ. is shown a powder crew loading a hole high on one of the abutments.

energy. We are sure we can break him in to do the job."

It is to promote a river that Friant Dam is being built. On August 6, approximately 66 per cent of its ultimate 2,160,000 cubic yards of concrete had been poured. The structure is not huge compared with the present concrete super dams, holding a modest fourth place in the contest for the "country's largest." In cubical contents it is topped by Boulder, Shasta, and Grand Coulee dams, the last overshadowing them all in this respect. Nevertheless, it is of great importance because it is the balance wheel, so to speak, that will maintain the rhythm of the whole Central Valley Project when all the parts have been completed and the works wound up to go.

A number of novel features and methods of construction are identified with Friant Dam. It is going to be what might be termed a streamlined, "case-hardened" structure embodying a new material. Its builders are proud of it. But a description of the dam itself and the refinements entering into it would not be complete without reference to other parts of the undertaking, their relationship, and what is going to be accomplished by the facilities that are being provided.

Map 1 reveals the fundamental reasons for the Central Valley Project. Nature has endowed this 500x50-mile area with substantially everything it needs—soil, climate, and mountain watersheds. But Nature failed to coördinate them properly, the water distribution and the irrigable lands being out of balance both geographically and seasonally. There are two main river systems in the valley, the Sacramento that comes down from the north and the San Joaquin that comes from the east and south. They meet in the very productive delta lands at the end of an arm of San Francisco Bay.

As regards the geographical unbalance, the Sacramento River carries seven-tenths of all the water delivered by the two streams, yet its basin contains less than one-fourth of the irrigable land: the San Joaquin, with only three-tenths of the water, has in its basin croplands with more than three-fourths of the irrigation needs. The cause of the seasonal unbalance is that most of the moisture that falls on both watersheds flows unused to the ocean in spring and early summer, leaving a paralyzing shortage in the late-summer and fall growing seasons.

More specifically, the Sacramento River and its tributaries have a mean annual flow of 21,000,000 acre-feet and irrigate about 500,000 acres of land. Approximately 90 per cent of the water escapes to the Pacific and is not only wasted but some years also does flood damage aggregating millions of dollars. On the other hand, the San Joaquin system, with a mean annual flow of 8,500,000 acre-feet, now has 2,000,000-odd acres of land dependent upon it for irrigation and there are several million more that could be cultivated if sufficient water were available. In the central and southern areas of the valley most of the water for irrigation comes from wells. Pumping from these sources of supply has lowered the water table progressively, and the wells have gone deeper and deeper. In some sections the cost of raising water is too great to continue pumping, and many thousands of acres of land already have been abandoned while the production of a million more is jeopardized.

It is to remedy this lack of coördination that the Central Valley Project is being built. It involves redistributing the irrigation water; flood control of the two

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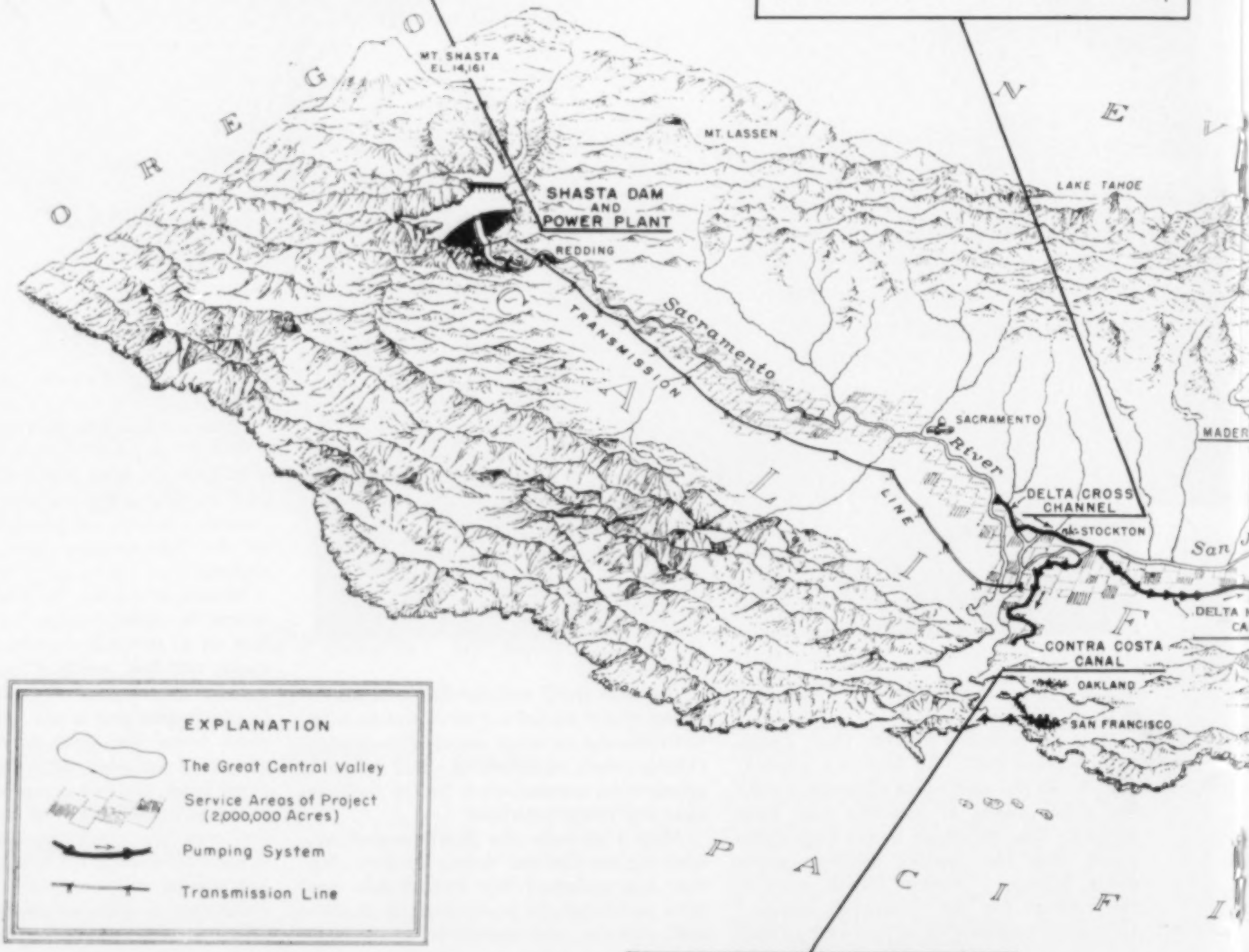
SHASTA DAM AND POWER PLANT

Second-largest masonry dam in the world, it will be a curved, gravity-section overflow-spillway-type structure 560 feet high and 3,500 feet long, requiring 6,000,000 cubic yards of concrete. The reservoir covering 29,600 acres will have a capacity of 4,500,000 acre-feet. This storage will permit restoration of navigable depths on the Sacramento River; provide increased flood protection in the upper valley; afford river regulation to repel salt-water encroachment in the delta area; and furnish conserved water for supplemental irrigation in the Sacramento Valley and for export to the San Joaquin Valley. Five 75,000-kva. generator units will produce annually about 1,500,000,000 kw-hrs. of electric energy. The reservoir will provide wild life and recreational facilities. Keswick Dam, nine miles below Shasta, is designed for afterbay regulation and will be provided with three 25,000-kva. power units.

DELTA CROSS CHANNEL

To facilitate fresh-water flushing of the sometimes salty waterways of the Sacramento-San Joaquin delta, and to introduce an adequate supply to the intakes of the Contra Costa Canal and the Delta Mendota Canal, 8,000 second-feet of water from the regulated Sacramento River will be diverted southerly across the head of the delta in a channel 50 miles long.


OREGON
MT. SHASTA
EL. 14,161
MT. LASSEN
NEV
LAKE TAHOE
SHASTA DAM
AND
POWER PLANT
REDDING
TRANSMISSION
LINE
Sacramento
River
SACRAMENTO
CALIF
MADER
DELTA CROSS
CHANNEL
STOCKTON
San J
DELTA
CA
CONTRA COSTA
CANAL
OAKLAND
SAN FRANCISCO
PACIFI
EXPLANATION
The Great Central Valley
Service Areas of Project
(2,000,000 Acres)
Pumping System
Transmission Line

CONTRA COSTA CANAL

A year-round fresh-water supply maintained in the delta by Shasta Reservoir operation will be taken out near Rock Slough close to Stockton, boosted to an elevation of 124 feet by four pumping plants, and conveyed westerly in this 46-mile canal to serve an upland agricultural area, many industrial plants in the upper Bay region, and a number of Contra Costa County municipalities. The canal will have a diversion capacity of 350 second-feet.

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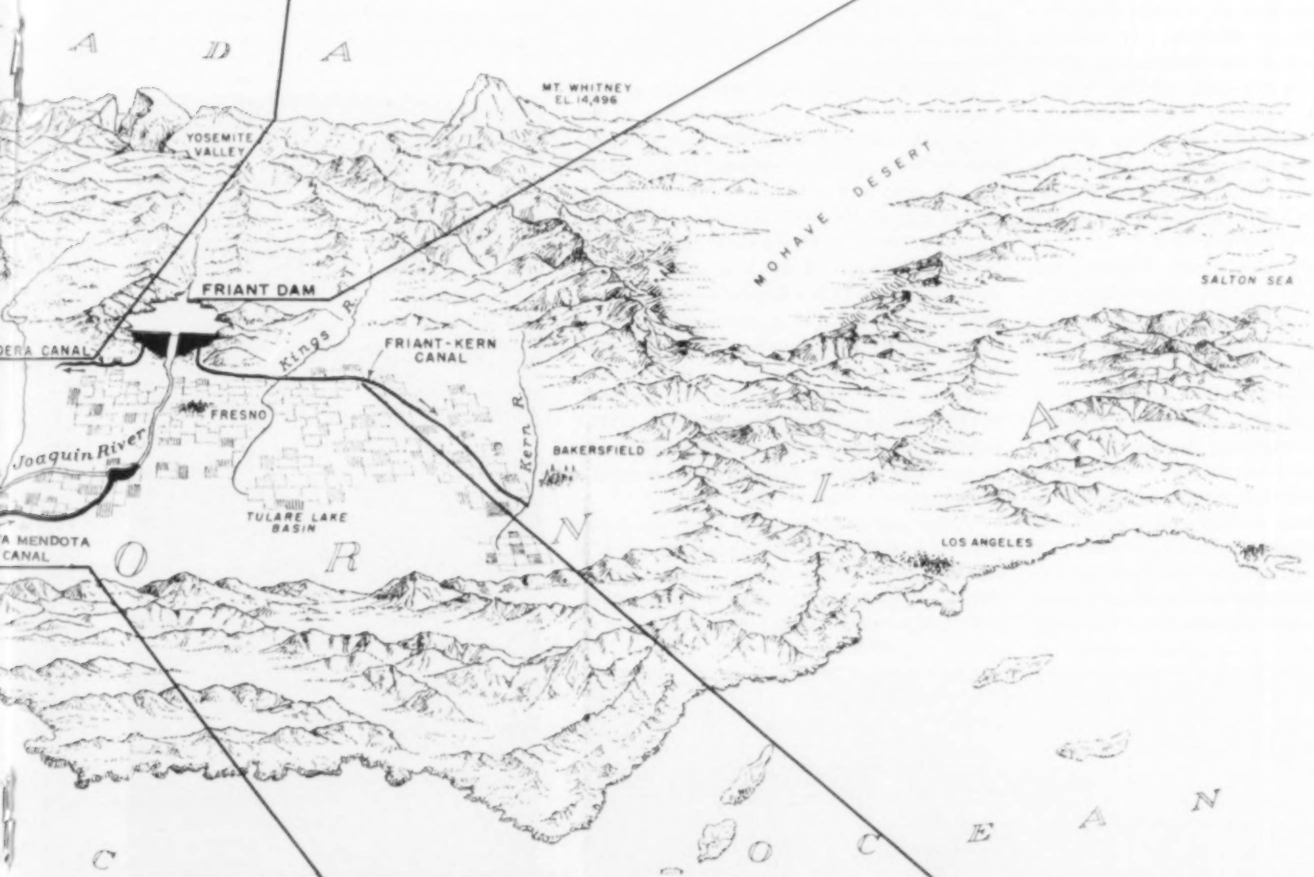
MADERA CANAL

Diverting from Friant Reservoir, this 37-mile-long gravity canal will have an initial capacity of 1,000 second-feet to deliver water to irrigated lands in Madera County in need of a supplemental supply. In its upper reaches the canal will be 10 feet wide at the bottom, will carry water 9 feet deep, and will be 36 feet wide at the top of the concrete lining.

FRIANT DAM

Fourth largest masonry dam in the world, it will be a straight gravity-section, overflow-spillway-type structure 320 feet high and 3,430 feet long, requiring 2,160,000 cubic yards of concrete. The reservoir, covering 4,800 acres, will have a capacity of 520,000 acre-feet and will provide increased flood protection, San Joaquin River regulation, and much-needed irrigation storage. Water will be diverted at the dam through the Madera and Friant-Kern canals for supplemental surface irrigation in parts of five counties where there is an existing shortage and to facilitate ground-water recharge in areas suffering from underground storage depletion because of excessive irrigation pumping. The reservoir will afford additional wild life and recreational facilities for the San Joaquin Valley.



DELTA MENDOTA CANAL

Crop lands along the lower San Joaquin River now using water that henceforth will be stored and diverted at Friant Dam are to be given in exchange a substitute supply from the more abundant Sacramento River. Part of the surplus made available by Shasta Reservoir, and conveyed through the delta by the Cross Channel, will be pumped out near Stockton, raised to an elevation of about 200 feet, and carried southerly in this 3,000-second-foot canal a distance of more than 100 miles. In addition to the exchange supply, the canal will furnish new water for supplemental irrigation in the northern San Joaquin Valley.

FRIANT-KERN CANAL

With a diversion capacity of 3,500 second-feet, this 160-mile-long canal will carry supplemental water by gravity from Friant Reservoir to irrigated lands in Fresno, Tulare, Kings, and Kern counties where serious agricultural retrogression is threatened by the inadequacy of the present water supply. The initial section of the canal will be 35 feet wide at the bottom, 15 feet deep, and 70 feet wide at the top of the concrete lining.

great rivers; improving navigation on the Sacramento as far north as Red Bluff; preventing salt water from San Francisco Bay from encroaching on the rich delta lands; furnishing fresh water for industrial and municipal uses in the upper Bay region; and the production annually of 1,500,000,000 kw-hrs. of electricity for operating the project pumping plants as well as for industrial, municipal, and agricultural purposes. All told, the undertaking is expected to cost approximately $264,000,000. To date, Federal funds totaling $107,000,000 have been appropriated. It may not be the largest single Bureau of Reclamation project from the standpoint of cost; but from the engineering viewpoint it is probably one of the most varied and exciting.

Just how the rivers are being switched around, the flood waters will be controlled and made useful, and the salt of the ocean kept away from growing crops can best be followed by studying the map on the preceding pages that shows and describes the features of the scheme. It includes Shasta Dam across the Sacramento River and near the north end of the valley; Keswick Dam, 9 miles below Shasta; a network of canals with pumping plants; hydro-electric stations; and, at the southern end, Friant Dam athwart the San Joaquin. It is with the latter structure that this article is concerned.

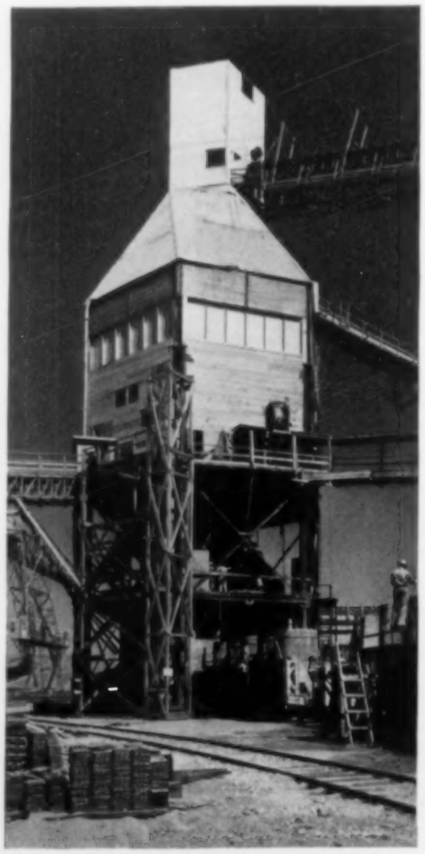
As previously mentioned, Friant Dam will be the balance wheel of the entire system, for without this structure large amounts of the surplus water from the Sacramento River would still be wasted despite the regulating effect of Shasta Reservoir and the southern end of the Central Valley would continue to parch. The reservoir to be created by it will cover 4,800 acres and will have a capacity of 520,000 acre-feet. It will afford flood protection and supply irrigating water that will be drawn as needed through the Friant-Kern Canal and the Madera Canal, both of which are described on the map. No power will be generated at this point in the system: the dam will serve only for the storage of water.

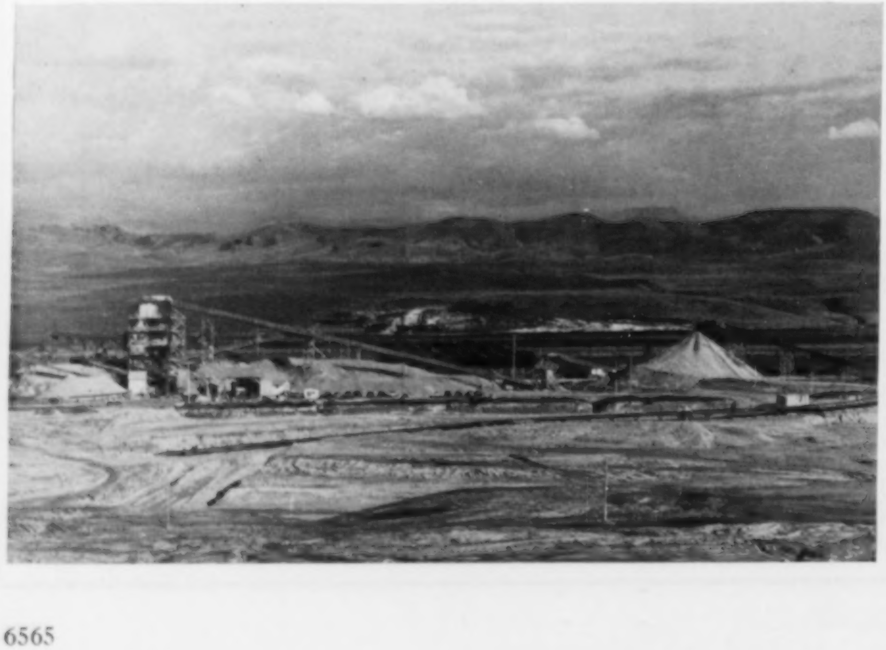
The contract for the structure was awarded to the Griffith Company and Bent Company, of Los Angeles, Calif., the principal contractor. As is usually the case on Bureau of Reclamation projects, the latter is supplying the materials for the dam and permanent works, while the contractor is furnishing labor and equipment and such materials as are necessary in connection with the work of construction. The total cost of the dam will be about $20,000,000. As of August 1, 1941, on the basis of the latest figures on excavating and concreting requirements, the Griffith Company and Bent Company contract will amount to $11,500,000. It will involve the removal of upwards of 1,300,000 cubic yards of earth and rock, of 860,000 cubic yards of overburden from the gravel deposit, the handling of approximately 3,650,000 tons of sand and gravel, and the placing of 2,160,000 cubic yards of concrete for the dam and appurtenant works.

Ground for the dam was broken November 5, 1939. In expectation of its completion around the latter part of 1942, the Bureau recently ordered drum gates for the spillway and trash racks for the protection of the river and canal outlets. Three years is a short time in which to build a structure of this size, especially in view of the fact that it may be termed the proving ground for a number of ideas conceived by the Bureau engineers. It is safe to say that on few jobs of its kind has so much work been accomplished per unit of equipment or unit of man-power. This applies especially to excavating, aggregate production and handling, and concrete placement.

Take concrete pouring, for example. The record at Friant so far has been 9,059 cubic yards in 24 hours (three 8-hour shifts). The biggest month has been 225,000 cubic yards. From the standpoint of magnitude of operations this was, of course, greatly surpassed at Grand Coulee Dam where 396,000 cubic yards were placed in one month under the Mason-Walsh-Atkinson-Kier Company contract and 536,000 by Consolidated Builders, Inc. But one thing to remember is that at Grand Coulee the former had seventeen rigs of all kinds on the trestle and the latter a total of 22. These included the two great hammerhead cranes now operating at Friant, together with various other larger and smaller cranes and derricks. There were also two mixing plants, one at each end of the trestle. Griffith Company and Bent Company has only one 4-mixer plant and six rigs for pouring concrete that are comparable to those mentioned above. On that basis it will be seen that in the biggest month—the all-time high—at Grand Coulee was placed 2.38 times as much concrete as at Friant, but with 3.66 times the equipment.

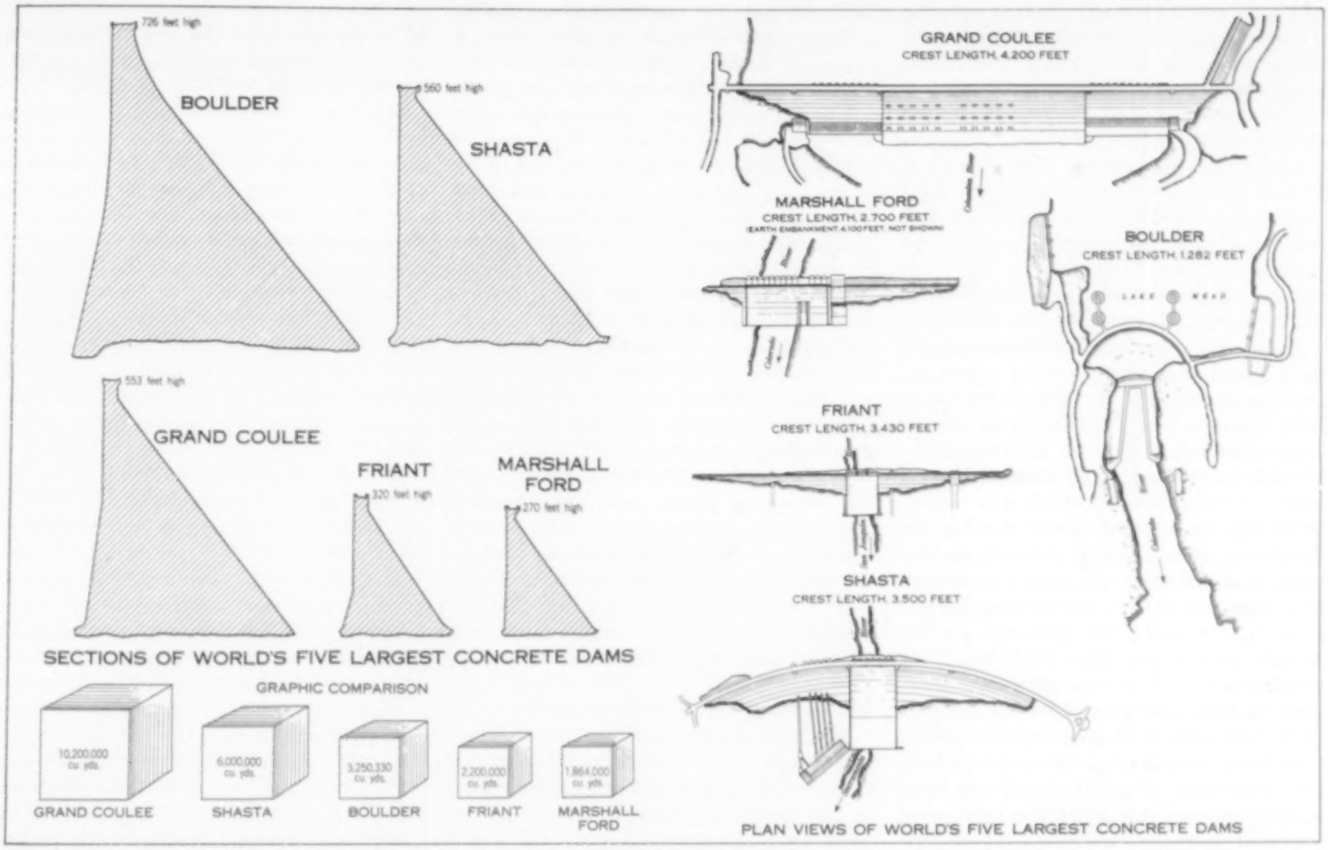
Records or no records, a fine dam is being constructed and credit for the accomplishment is due to the men who are





GRAVEL TREATING AND CONCRETE MIXING

Aggregates for concrete are obtained from a pit 3 miles from the dam site and processed into four sizes of gravel and two sizes of sand in a plant (left) that is claimed to be as efficient as any ever built. It was constructed largely of used materials in four months, the engineering being done by the Stephens-Adamson Manufacturing Company. Concrete is mixed in the 4-mixer plant shown above.


726 feet high
BOULDER
560 feet high
SHASTA
553 feet high
GRAND COULEE
FRIANT
320 feet high
MARSHALL FORD
270 feet high
SECTIONS OF WORLD'S FIVE LARGEST CONCRETE DAMS
GRAPHIC COMPARISON
10,200,000 cu. yds.
GRAND COULEE
6,000,000 cu. yds.
SHASTA
3,250,330 cu. yds.
BOULDER
2,200,000 cu. yds.
FRIANT
1,864,000 cu. yds.
MARSHALL FORD
GRAND COULEE
CREST LENGTH 4,200 FEET
MARSHALL FORD
CREST LENGTH, 2,700 FEET
(EARTH EMBANKMENT 4,100 FEET, NOT SHOWN)
BOULDER
CREST LENGTH 1,282 FEET
LAKE MEAD
FRIANT
CREST LENGTH 3,430 FEET
SHASTA
CREST LENGTH 3,500 FEET
PLAN VIEWS OF WORLD'S FIVE LARGEST CONCRETE DAMS

COMPARISON OF SIZES

If it had been completed ten years ago, Friant Dam would have been the largest concrete dam in existence. Right now it ranks behind Grand Coulee, Shasta, and Boulder. Above are graphic comparisons of the five largest concrete dams in the world. All of them have been or are being built by the Bureau of Reclamation.

running the job. M.H. Slocum, general superintendent for the contractor, is a dam builder by instinct and training. He is on the job and all over it most of the time; and when he is not there he is generally in his air-conditioned house on top of a bare hill from which he can see every part of it from the hole to the gravel plant 3 miles away. The secret of his success is that he always has around him top men who not only know their stuff but do it.

The dam is of the straight gravity type and will have a maximum height of 320 feet and a length of 3,430 feet. It is being built of concrete in blocks in which the piping systems for cooling and grouting are embedded as the work progresses. Holes have been and are being drilled in the foundation for first-stage and for subsequent deep grouting to provide an impervious curtain in the underlying rock. In these respects, the construction follows standard practice; but in design, materials, and methods of building there are some departures. Among these are: mixing of pumicite with the cement (the first time, except in an experimental way, that this material has entered into the construction of a dam); use of absorptive form linings; almost 100 per cent utilization of cantilever-type forms; and preliminary cooling of the concrete aggregates and the cement, including precooling of the mixing water by means of slush ice. All these will be more fully discussed later.

Among the first equipment on the job was a fleet of nine 14-yard Le Tourneau self-loading carry-alls drawn by RD8 Caterpillar tractors. On the abutments, working downhill to each of the service-road levels, they lost no time in stripping the surface material, including a lot of weathered rock on the right abutment after it had first been loosened with a rooter and light blasting. Fourteen wagon drills—of which twelve were Ingersoll-Rand units mounting X-71 drifters—supplemented by JA-55 Jackhamers, were then brought in for the heavy work. The rock is a fairly uniform quartz mica schist and is rather hard to drill. In some tests it showed a crushing strength of 7,500 pounds per square inch, and only a 2-foot hole could be drilled with each change of steel. The holes ranged from 20 feet deep and 6 feet apart at the start to 6 feet deep and 3 feet apart as the foundation was approached. Giant or Hercumite 40 per cent explosive was used for blasting—not more than a quarter stick per foot for 6-foot holes or less and half a stick for deeper ones. When the rock work could no longer be handled by the carry-alls, excavating was finished by shovels loading into trucks—three Limas, one P.&H., and one Lorain, all diesels with 1¼- to 2¼-yard buckets.

Air for the drilling operations was supplied by a central compressor plant of seven units with a combined capacity of 8,100 cfm. Seven 12x4-foot receivers were spotted at the plant and in the field so that dry air at substantially the full pressure of 100 pounds was available at all points of use on the site. "Air is like money—something you never seem to have enough of no matter how much you try to lay by," said Jim Devine, the master mechanic. "On this job, we made up our minds we were going to have all the air we could spend for once. And so we did spend it generously. Then, recently, along came this slush-ice business for cooling the mixing water, and we had to switch our biggest compressor over into an ice-making machine. But at this stage of the work I guess we will get by all right."

Along the south bank at the dam site was dug a temporary diversion channel 1,700 feet long and 50 feet wide to carry the flow of the river while the stream bed was excavated and the lower blocks of the dam were poured in the northern and central part of the area. The channel had gunited sides, with a timber-flume section traversing the dam area proper, and was designed for a peak flow of 10,000 second-feet. The upstream cofferdam that was built to turn the water into the channel had concrete walls bulwarked with earth and rock and a closeable 25-foot opening in the center. A rock-filled timber crib constituted the downstream cofferdam. Pumps were kept going to permit uninterrupted excavating and concrete placement at this stage of the operations. As concreting progressed, three conduits, each 14 feet in diameter, were left in the base of the structure. When the latter had reached a sufficient height, the river was diverted through the conduits, the temporary channel closed, and the remainder of the dam foundation excavated.

Sand and gravel for making concrete were found in a fairly well-balanced deposit approximately 3 miles downstream from the dam site. The first step was to remove about 6 feet, or approximately 860,000 cubic yards, of overburden on some 55 acres of land, which now constitutes the gravel pit. After the big Le Tourneau carry-alls had finished preliminary excavating at the dam abutments, they were set to work uncovering the deposit and wasting the material on the nearby river bank. With that done they started on the job of excavating and transporting the aggregates to field hoppers each equipped with a concentric feeder that loads the material on to two 36-inch belt conveyors. The latter converge upon a junction box from which the aggregates are carried by a 42-inch belt to the raw stock pile which has a capacity of 3,500 tons, live storage. It will be necessary to work most of the pit area down to a depth of 25 or 30 feet. In some places where water collects and where it is impracticable to run the tractors and carry-alls, a Bucyrus-Erie 100-B dragline, with a 3½-yard bucket, digs the material and deposits it where the carry-alls can get it.

The aggregate plant produces four sizes of gravel and two of sand. The range of gravel sizes is: 3/16 to ¾ inch, ¾ inch to 1½ inches, 1½ inches to 3 inches, and 3 to 8½ inches. It is deposited adjacent to the plant, each in its own pile of 1,500 tons capacity. At an angle to this row is the 6,000-ton sand pile. Belt conveyors extend under each of these piles and convey the materials to car-loading hoppers. On their journey to the latter from raw storage, the aggregates travel by 36-inch belt to a scalping screen with 8½-inch openings feeding a gyratory crusher; thence by 36-inch belt to a 20x20-foot surge bin in the screening plant; and after passing through the screens, by 24- and 30-inch belts first to the storage piles and then to the track hoppers. Sand for cleaning rock and concrete surfaces by the blasting method is also produced and kept in separate storage, from which it goes through a drier to an elevated 100-ton tank. All sand is classified by hydroseparator.

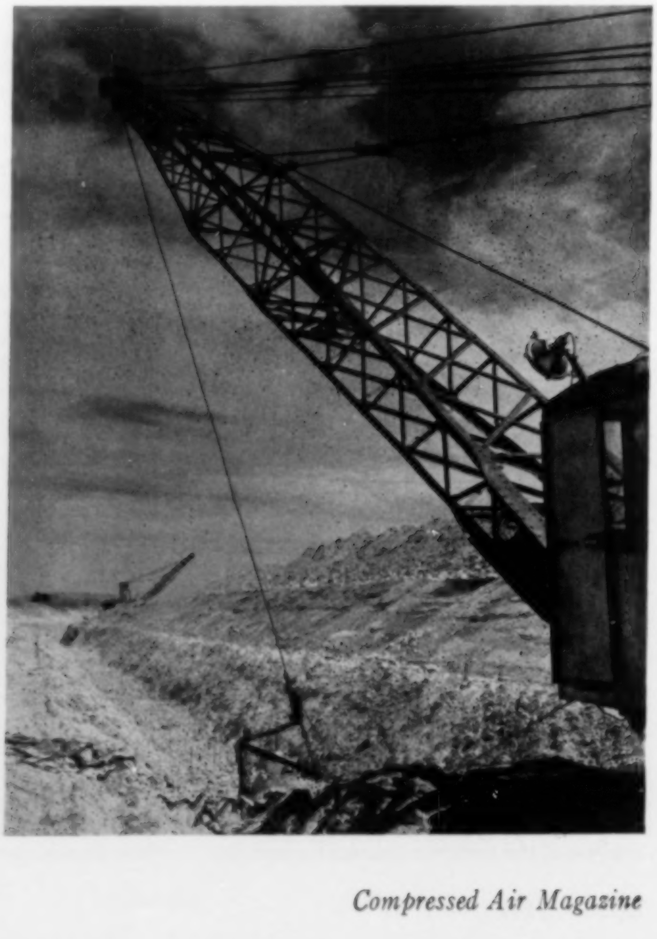
All the sand and gravel, as it comes from the borrow pit, contains from four to six cents worth of gold per cubic yard. This is not enough to permit working the deposit for the mineral alone; but as the material has to be handled anyway, it is passed through screen-lined chutes from which the heavies or values go to jigs and then to an amalgamator. As Uncle Sam owns the land from which the aggregates are obtained, he and the contractor go 50-50 on the take after the cost of the simple recovery installation has been retired. So far, $75,616 has been divided.

While belt transportation of aggregates is becoming popular—Shasta, with its 10-mile belt being the leader, the conditions at Friant favored the use of a railroad. One of standard-gauge, 3 miles long, was therefore built for that purpose. The motive equipment consists of two 43-ton diesel-electric locomotives, one at the front and one at the rear of a train. The cars are loaded at the gravel plant direct from the track hoppers, which are equipped with air dumps. At the end of their journey they unload the material right on the main stock piles from which an 1,800-foot belt finally conveys it to the bins of the mixing plant. The railroad has a switching yard at the dam and also connects with the Southern Pacific Railroad at Friant where the cement, coming from various producing plants, is delivered. A third 43-ton locomotive serves at this point to assist in transferring the material to four steel silos of 5,900 barrels capacity each. This is done by two Type D Fuller-Kinyon pumps which are supplied with air from a 100-hp. compressor. From the silos a screw conveyor transfers the cement to the main pneumatic conveyor system by which it is blown through a pipe to the mixing plant, the air for this purpose being provided by a 150-hp. compressor.

This article is in two installments. The second one will appear in the November issue.

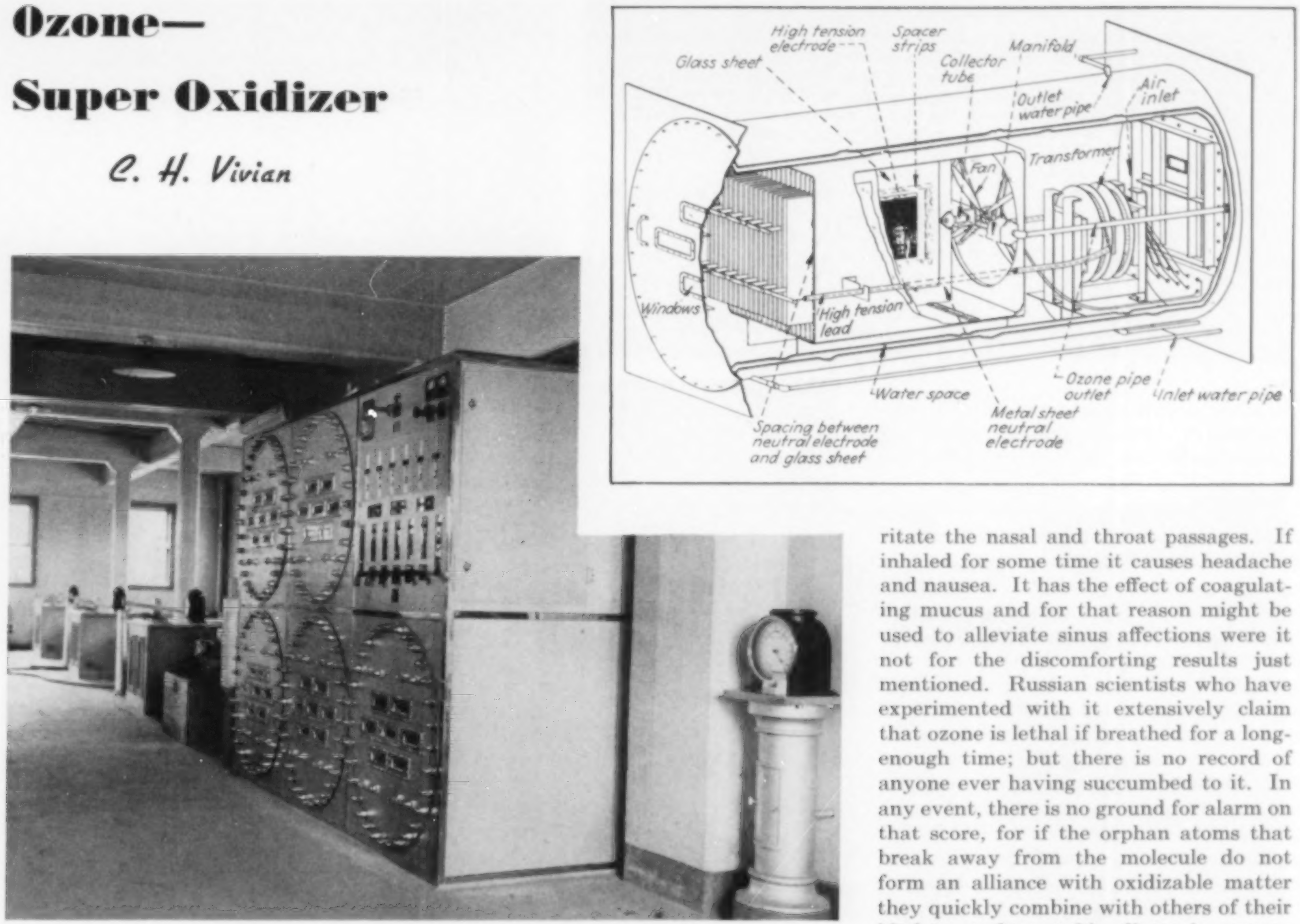
MADERA CANAL

Excavating of the Madera Canal, which will divert 1,000 second-feet of water from Friant Reservoir to croplands in Madera County, is already in progress. The picture at the right shows two draglines at work digging the 40-mile ditch that will be lined with concrete. At one point the canal will be carried across a deep draw by a concrete siphon with an inside diameter of 11¾ feet. Below is a view of the steel reinforcing for this section.



Ozone—Super Oxidizer

C. H. Vivian



OZONATORS AT WHITING, INDIANA

The forward end of five ozone generators and their control panel, with the filter room at the left. These units have a rated capacity of 50 pounds of ozone a day, but have produced as much as 80 pounds. The drawing shows a section through one ozonator. Thoroughly dried compressed air enters at the rear and flows forward through the corona spaces of the dielectric assemblies which are inclosed in a metal housing. A yield of from 0.4 to 1 per cent ozone is obtained, depending upon the volume of air treated and the voltage applied. From the dielectric assemblies the air-borne ozone passes through a collecting tube into an aluminum header and is conducted to the ozonizers in which the water is treated.

OZONE, which is probably the most powerful oxidizing agent known to science, has long been recognized as a medium for purifying water. It has been successfully used for that purpose in Europe for 40 years; but it has had comparatively limited application in the United States for reasons that will be given later. In recent years, however, these limiting factors have been largely removed and there is now a growing trend in this country toward the ozonization of drinking water.

Ozone is pure oxygen, but it differs from ordinary oxygen in the make-up of its molecule. The latter contains three atoms in place of the usual two—that is, it is triatomic instead of diatomic. Its chemical symbol is, accordingly, O_3, whereas that of ordinary oxygen is O_2. The ozone molecule is 1½ times as heavy as the oxygen molecule, although the two are of equal volume. The molecular structure of ozone is an abnormal one, and the gas is consequently unstable. From the instant a molecule is formed, the extra atom of oxygen seeks to break away, and it does so within a relatively short time. Once on the loose, so to speak, it becomes a free agent with a great affinity for oxidizable material with which it may come in contact. That is why some chemists call it activated oxygen. Obviously, it is a much faster-acting and a more powerful oxidizer than the stable oxygen molecule, even though the latter is an effective, although slower, sterilizing agent that is continually at work in nature and that has been widely applied commercially.

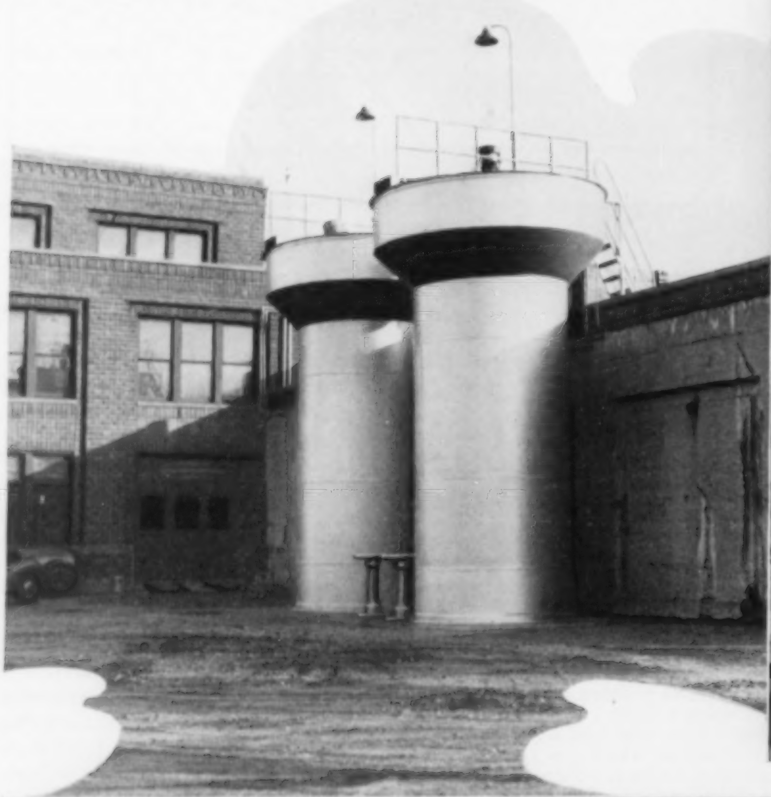
Ozone was discovered in 1785 by Van Marum and was named in 1840 by Schoenbein, who chose for it a Greek word meaning to smell. When diffused in small concentrations in air, ozone has a clean, refreshing odor, but in greater concentrations it is more pungent and somewhat resembles chlorine in character. It is not unpleasant to breathe and does not irritate the nasal and throat passages. If inhaled for some time it causes headache and nausea. It has the effect of coagulating mucus and for that reason might be used to alleviate sinus affections were it not for the discomforting results just mentioned. Russian scientists who have experimented with it extensively claim that ozone is lethal if breathed for a long-enough time; but there is no record of anyone ever having succumbed to it. In any event, there is no ground for alarm on that score, for if the orphan atoms that break away from the molecule do not form an alliance with oxidizable matter they quickly combine with others of their kind to produce stable, diatomic oxygen.

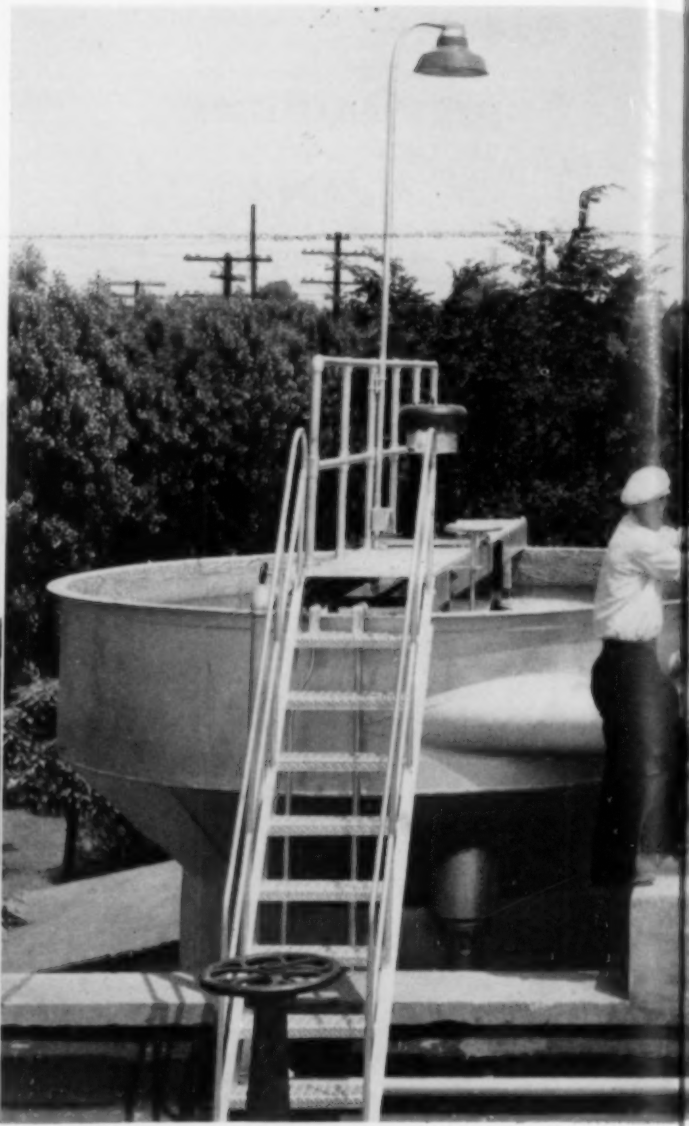
Ozone is formed in nature by electrical discharges accompanying thunderstorms, and man has patterned along generally similar lines his process of manufacturing it commercially. It is also the product of varying chemical reactions, electrolysis, and other means; but none of them is utilized outside the laboratory. The greatest use of ozone is as a bleach and, with a shortage of chlorine imminent, it may find increased application in this field. It is employed in various chemical industries for such purposes as refining oils, fats, and varnishes, and in the manufacture of perfume and of the flavoring extract vanillin. It has served abroad for many years in the aging of wood.

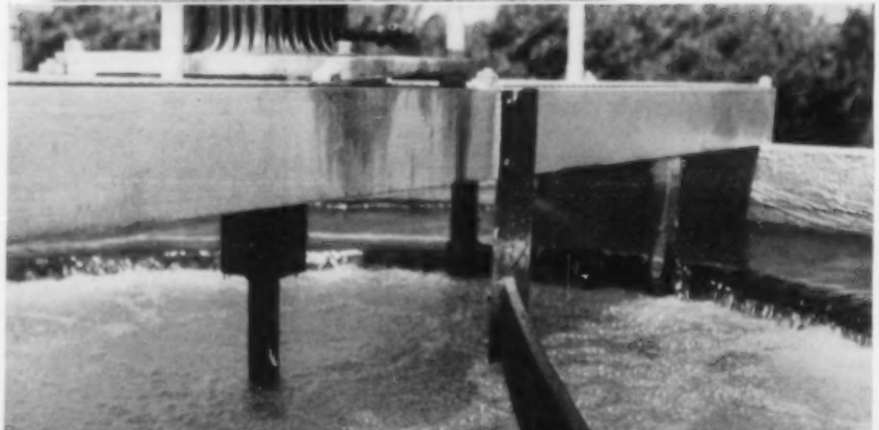
In water, ozone has the same general effect as chlorine in that each attacks organic and mineral matter and acts as a bactericide and germicide. But ozone has some important advantages. Chlorine's oxidizing action is indirect, the chlorine reacting with the water to form hydrochloric acid and hydrochlorous acid which releases monatomic oxygen. Ozone, as we have seen, is a direct oxidizing agent and one far superior to hydrochlorous acid or atmospheric oxygen. Furthermore, ozone does not introduce any new chemical element and, after performing its work, escapes to the atmosphere without leaving any trace of its stay there. Chlorine, on the other hand, combines with

WHITING OZONIZERS

Just below is an exterior view of the filtration plant showing the two 8x21-foot steel tanks in which the ozone and water meet. The air stream, containing the ozone, is introduced at the bottom and bubbles up through the water, causing its surface to boil as illustrated in the lower picture. The water is pumped through a 16-inch line to the level of the tank tops, where it divides into two 12-inch lines leading into the ozonizers (right). Each line enters a circular trough, surrounding the ozonizer proper, where sediment settles out. The water flows over the inner edge of this trough into the tank, providing uniform distribution and preventing short circuiting. The treated water is drawn out at the bottom of the tank after a detention period ranging from 4 to 8½ minutes, depending upon the volume run through the plant. The drawing is a flow diagram of the water-treatment plant at Whiting.



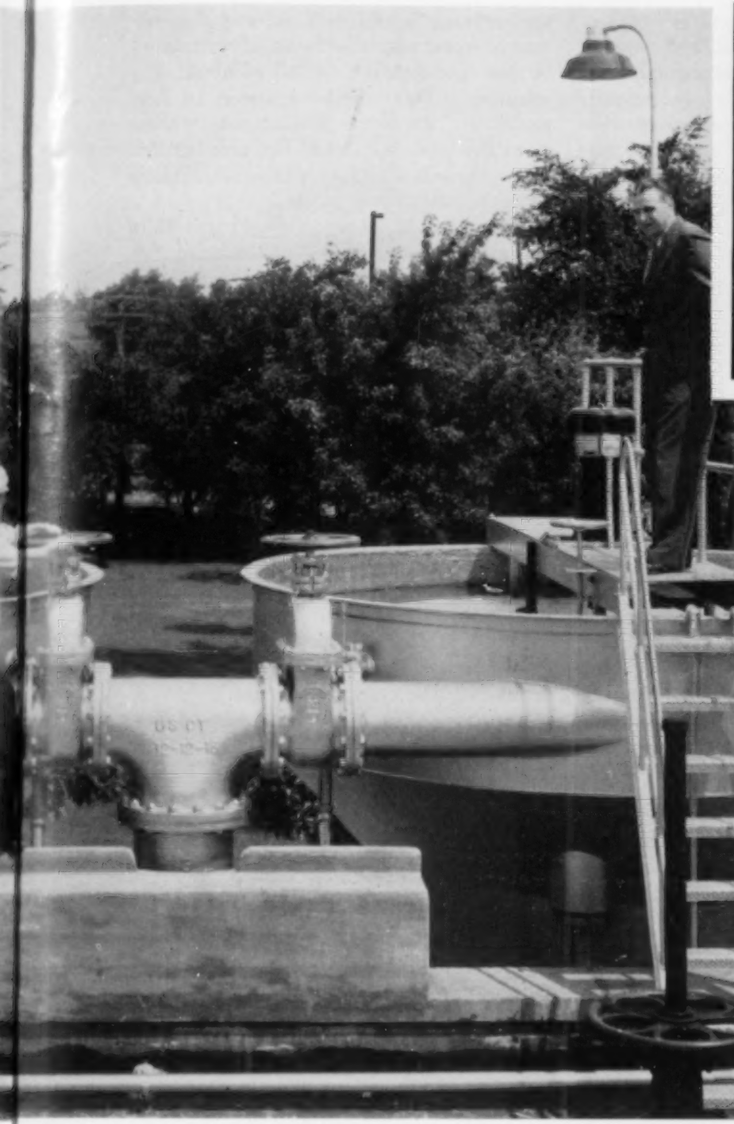


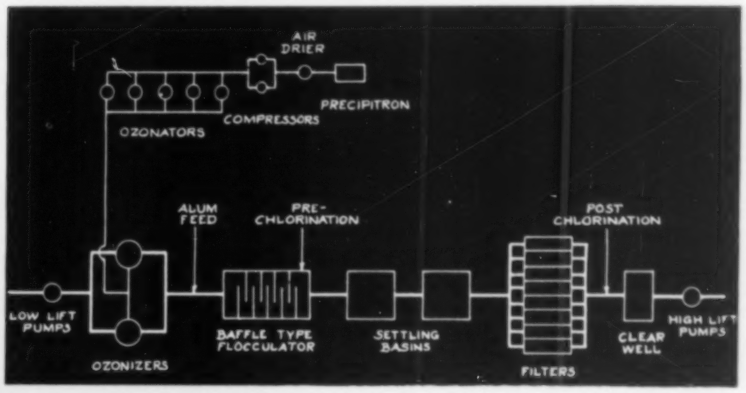


some organic compounds in water, particularly those of a phenolic character, to form chlorphenols and other complex soluble compounds that impart disagreeable medicinal and musty tastes.

Ozone is not advocated, however, as a substitute for conventional water-treatment processes, but rather as a supplementary measure. Prevailing methods of filtration, accompanied by chemical treatment, render water safe for drinking purposes and are generally satisfactory from the standpoint of public health. But oftentimes the water is not palatable. It is in the field of eliminating bad tastes and odors that ozone proves most valuable.

More than 100 ozonizing plants are in operation in water works in France alone, and others are functioning elsewhere in Europe. When the present war broke out there was nearing completion a plant large enough to treat daily 79,000,000 gallons of Paris's water supply. In the United States, the ozone treatment of municipal supplies has not been widely adopted in the past chiefly because of the high cost of electricity, which is required for making





ozone, and the inefficiency of the generating apparatus.

As long ago as 1906, experiments with ozone were conducted by the City of New York with a view to its possible use in treating the public water supply, but the method was not adopted. Ann Arbor, Mich., tried out the process from 1908 to 1914, and then abandoned it. Delhi, N.Y., used ozonization from 1928 to 1935, but the plant was washed out and never replaced. Long Beach, Ind., installed equipment in 1930; and Hobart, in the same state, followed suit in 1932. Both plants have been in service ever since and have given successful results, although their operating costs are higher than those of the apparatus developed in the meantime.

The current interest in ozone is attributable to J. M. Daily, an American engineer who was associated for several years with the leading French manufacturer of equipment for ozonizing public water supplies. With a view to adapting the process used abroad to American engineering practice, he conducted researches and then returned to the United States and formed the American Ozone Corporation. He continued his experimental work here and developed equipment that would meet conditions in this country. Three years ago the activities of his concern were taken over by Ozone Processes, Inc., which has further increased the efficiency of the apparatus and improved upon its application. The latter concern is a wholly owned subsidiary of the Welsbach Street Illuminating Company. Since entering the field, it has made installations in Denver, Pa., and Whiting, Ind., and has set up pilot plants in several other cities for the purpose of ascertaining what ozonization will do for their water supplies.

Although ozone is a comparative newcomer in the municipal-water-supply field in this country, it is being used for treating water in swimming pools, and small apparatus are being employed in homes and by bottling companies to ozonize relatively small amounts of drinking water. The pool used by the performers in Billy Rose's Aquacade at the New York World's Fair was provided with ozonizers. The contractor was delayed in getting them ready for service, and chlorination was temporarily resorted to. As the swimmers were in the water for protracted periods each day, they suffered from smarting eyes and other discomforts which caused much disaffection in their ranks. Happily, ozone was substituted after a few weeks and the complaints ceased. At the new Ward's Island sewage-disposal plant in New York City, ozone renders inoffensive the odors that escape to the atmosphere.

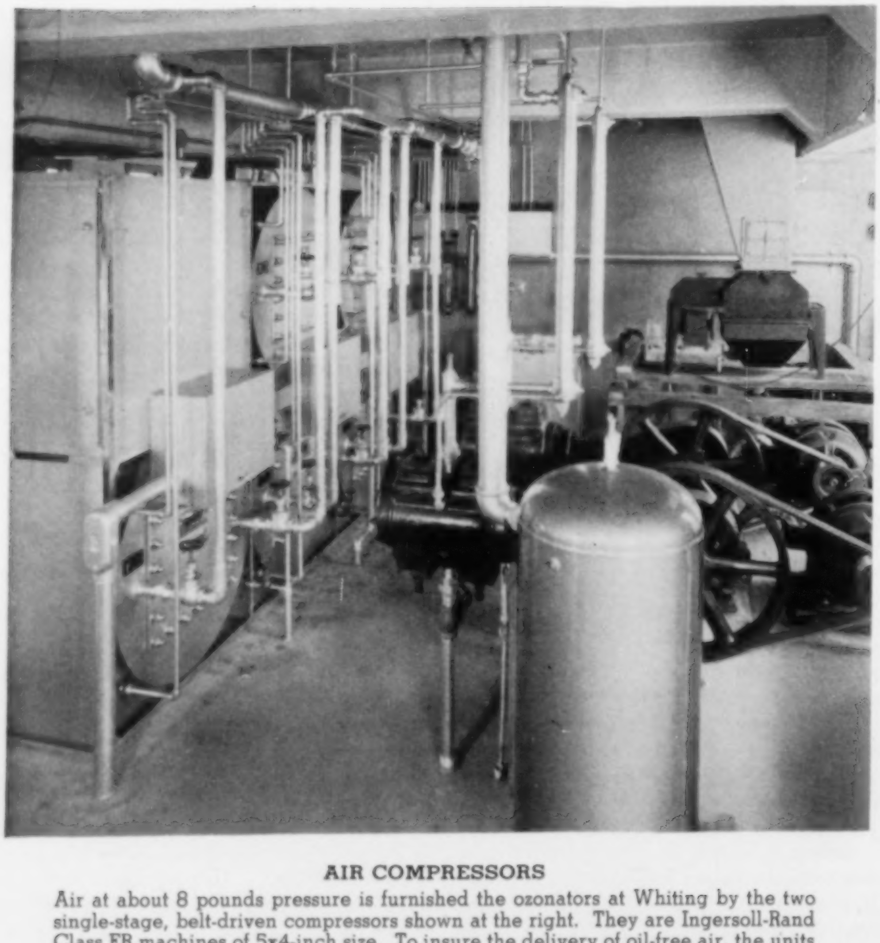
The latter reference directs attention to one of the chief ways in which ozone benefits drinking water. It serves to convert unpleasant tastes and odors into pleasant ones. This can be accomplished by chemical means, but not with the same degree of surety and generally not at the same cost. Tastes and odors are so closely allied as to be inseparable. There are only four fundamental tastes—acid, bitter, sweet, and salt. All others are either combinations of these or, more commonly, taste sensations modified by smell. If a truly palatable water is desired, it is therefore just as important to remove objectionable odors as it is to eliminate bad tastes.

There is no machine that will detect odors: only the human nose can do this. Nevertheless, sanitary engineers have established a set of standards relating to odors. The unit of measure is known as the Threshold Odor Number. To ascertain it, a sample of the odorous water is diluted with an equal amount of odorless water, the latter being distilled water treated with activated carbon. The Threshold Number is the number of times the water has to be diluted to make the odor just detectable by the human nose. Of course, there is the inevitable factor of error; but trained sniffers will usually check one another fairly closely.

The Threshold Odor Numbers of some waters supplied by municipalities are unbelievably high. For instance, the raw water taken from the Saginaw River for the City of Saginaw, Mich., has a Threshold Number ranging from 62 to 4,000, depending upon the season, and after being treated for distribution the number at times reaches 2,000. The river receives wastes from sugar-refining mills, oil fields and oil refineries, and chemical plants. Tests with a view to eliminating the odors or making them inoffensive have been carried out by Ozone Processes in a pilot plant that was operated for nine months, and the Saginaw authorities are now considering the installation of ozonizing equipment. Although ozone will ordinarily reduce the Threshold Odor Number considerably, it will not always do so, in fact, it is not necessary in every case. Ozone's more important function is to change the characteristic of the odor, to render it unobjectionable, and it rarely fails to do this.

Ozone is customarily used abroad as an end treatment—that is, it is introduced after the water has been subjected to the usual chemical and filtration methods of purification and clarification. So far, however, Ozone Processes has found that better results are frequently obtained in this country by ozonizing the raw water. This has the effect of converting many organic and mineral substances into oxide forms that can later be filtered out and eliminated. In all cases where tests are made, the effects of introducing ozone at various points in the course of the existing process are studied and the results compared from the standpoints of both efficiency and economy. In general, the cost will be greater when raw water is ozonized, because there are more impurities in it at that stage and more ozone will be required to oxidize them.

The principal steps in the ozonizing procedure as practiced by Ozone Processes are: conditioning the air supply, generating the ozone, and introducing it into the water. The first of these consists of cleaning, compressing, and drying the air, which then goes to the ozone generator, or ozonator. In the latter it is passed through the corona created by the silent discharge of a high-tension electric current between a series of dielectric plates, and this converts up to 1 per cent of its contained oxygen into ozone. The stream of air carrying the ozone next flows into the bottom of a column of water through tubular porous Aloxite diffusers that divide it finely into bubbles that rise through the liquid. The water enters at the top and is withdrawn at the bottom, thus moving counter to the ozone. The contact column is 16 feet high, and the volume of water admitted is usually regulated to give a detention period of about 7½ minutes. This can be reduced to four minutes, however, without detracting from the effectiveness of the ozonization. The vessel in which this treatment takes place is called an ozonizer.



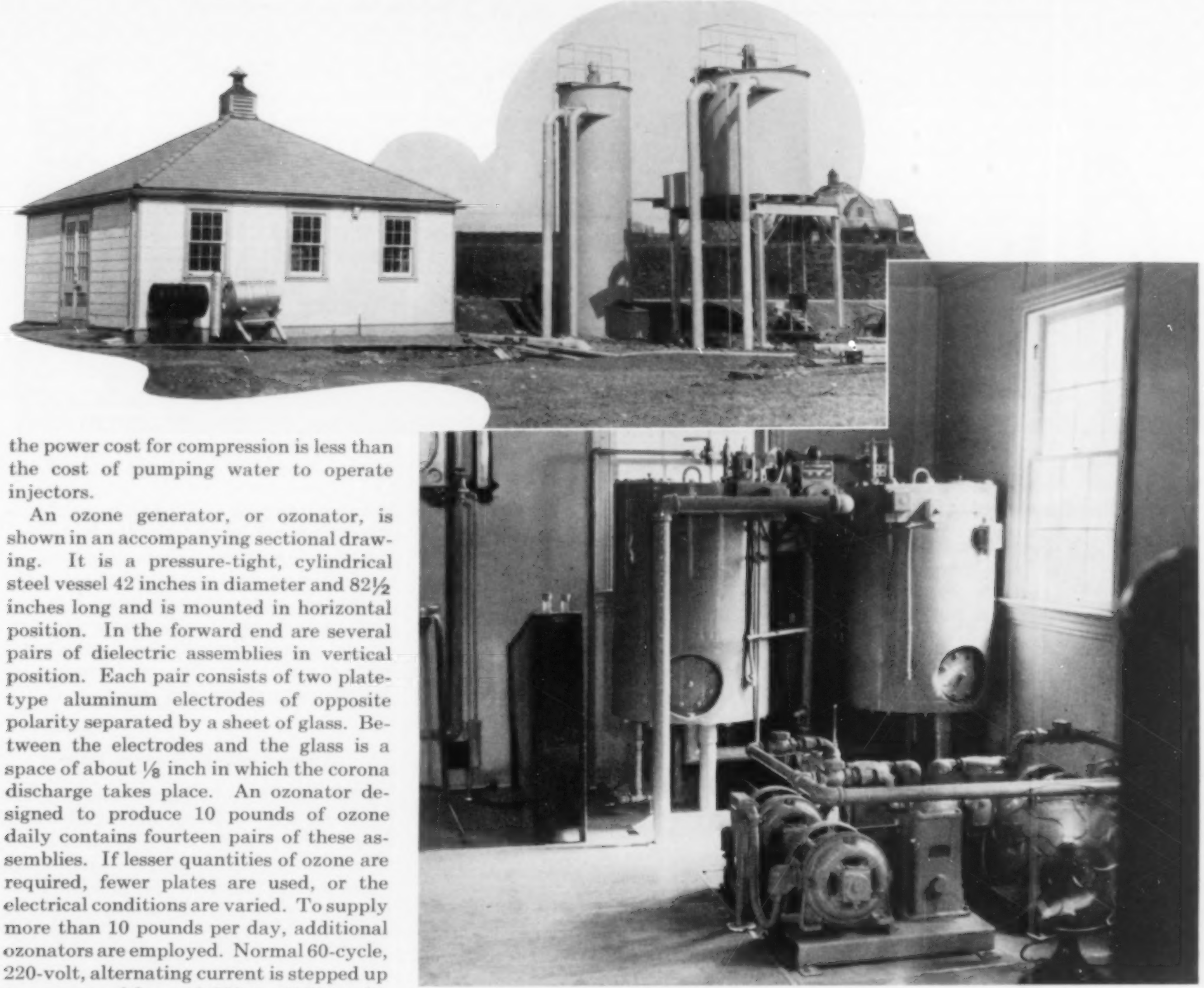
AIR COMPRESSORS

Air at about 8 pounds pressure is furnished the ozonators at Whiting by the two single-stage, belt-driven compressors shown at the right. They are Ingersoll-Rand Class ER machines of 5x4-inch size. To insure the delivery of oil-free air, the units are designed to operate without lubricant in their cylinders. Each has a capacity of 45 cfm., but the motor speed can be slowed to cut that volume in half. In this way it is possible to vary the air supply from 22½ to 90 cfm. For greatest efficiency of the ozonators it is supplied in the ratio of 2 cfm. per pound of ozone produced per day. The rear ends of the ozonators, with connected piping, appear at the left.

Clean, dry, and cool air is essential to the efficient functioning of the ozonator, so special, automatically operating equipment is provided for pretreating it. Intake air for the compressors is either filtered or, as at Whiting, Ind., is passed through a Westinghouse Precipitron, where dust and smoke particles are precipitated electrostatically. It is compressed to approximately 8 pounds, gauge pressure, which is sufficient to overcome the hydraulic head of about 7 pounds in the ozonizer water column plus the friction in the ozone generator and the delivery system. It is vitally important that no oil vapors or other contaminants become entrained in the air during the period of compression, and, to make sure of this, nonlubricated compressors are employed. These machines have been supplied to Ozone Processes by Ingersoll-Rand Company, and are the same as those utilized in chemical and food-processing plants, breweries, and distilleries. Their pistons are fitted with patented graphitic-carbon supporting rings and pressure rings that eliminate metallic contact and possess self-lubricating qualities that render it unnecessary to use oil, grease, glycerine, water, or any other lubricant.

The compressed air is cooled and part of its contained moisture is extracted in a tubular-type aftercooler, where it flows counter to circulating cooling water. For further moisture extraction the air is passed through driers containing beds of activated alumina. Two driers are employed, and the flow is directed to them alternately. The alumina in the unit not in service is reactivated by driving out the absorbed moisture with heat, which may be generated by electricity or gas, or obtained from steam. The same coils that provide the heat carry circulating water to cool the air when the drier is in use. The moisture content of the air is reduced to a dew point of less than -4°F. (0.4 grains per cubic foot).

The availability of activated alumina and silica gel as drying media has contributed to the increased efficiency of ozone generating equipment in recent years. Both of these materials were developed during the last World War and are superior to either refrigeration or calcium chloride, which were formerly used. The ozone generator made by Ozone Processes is the only one that has recourse to compressed air. All other systems use air at atmospheric pressure and injectors to introduce the ozone into the water being treated. The efficiency of ozone generation is optimum at a pressure of about 1½ atmospheres, absolute, and



PILOT PLANT

To ascertain the effects of ozone treatment on a specific water, and to work out the most effective operating procedure for a full-scale installation, a pilot plant, in which the existing chemical and filtration facilities are duplicated in miniature, is set up and run for as long as a year. The upper picture shows such a plant now being operated at the Lower Roxborough filter plant of the Philadelphia water-supply system. Inside the building is a 10-pound-per-day ozonator. It is furnished with air by the four Ingersoll-Rand Type N compressors seen at the right.

the power cost for compression is less than the cost of pumping water to operate injectors.

An ozone generator, or ozonator, is shown in an accompanying sectional drawing. It is a pressure-tight, cylindrical steel vessel 42 inches in diameter and 82½ inches long and is mounted in horizontal position. In the forward end are several pairs of dielectric assemblies in vertical position. Each pair consists of two plate-type aluminum electrodes of opposite polarity separated by a sheet of glass. Between the electrodes and the glass is a space of about ⅛ inch in which the corona discharge takes place. An ozonator designed to produce 10 pounds of ozone daily contains fourteen pairs of these assemblies. If lesser quantities of ozone are required, fewer plates are used, or the electrical conditions are varied. To supply more than 10 pounds per day, additional ozonators are employed. Normal 60-cycle, 220-volt, alternating current is stepped up to a range of from 13,000 to 18,000 volts by a built-in transformer in the rear end of the tank. The amount of ozone produced differs in accordance with the fluctuations in the volume and pollution of the water to be treated and is controlled by increasing or decreasing the voltage on the electrodes in steps of 500 volts each. The dielectric assemblies and the transformer are cooled by a draft of air created by a fan mounted between them. The air, in turn, is cooled by water flowing through coils and is then recirculated.

The quantity of ozone needed varies with the condition of the water, but 10 pounds will usually treat 1,000,000 gallons satisfactorily, even where pollution is bad. The cost of production depends upon the price of electric current. The over-all power consumption, including that of the compressors, will approximate 16 kw-hrs. per pound of ozone. Assuming a maximum of 10 pounds of ozone per 1,000,000 gallons of water treated, and a power rate of one cent per kw-hr., the cost will be $1.60. No additional plant operating personnel is ordinarily required.

The installation at Denver, Pa., a community of 2,100 persons, is designed to treat a maximum of 300,000 gallons of water daily and has a capacity of 5 pounds of ozone a day. The borough formerly had an adequate supply of spring water, but increased demands led to the construction of a dam across Cocalico Creek and of a conventional filtration and chemical treatment plant. During a drought in 1939 the water acquired disagreeable odors and tastes because of algal growths in the stream. These have disappeared since ozonization was adopted.

The ozonization plant at Whiting, Ind., treats from 2,000,000 to 4,000,000 gallons of water daily, the peak consumption being in the summer months. The raw water is drawn from Lake Michigan, the pump intake being about 1,400 feet offshore and between two bulkheads that form a harbor. Into this inclosed area is run the waste from 150 industrial plants and the sewage from a population of some 250,000 persons. Despite filtration and chemical treatment that rendered the water safe, it was unpalatable because of kerosene and phenolic tastes accentuated by the heavy chlorine dosing necessary to cope with the primary pollution.

A year of experimentation by means of a pilot plant disclosed that ozonization would eliminate the objectionable taste, and a 50-pound-a-day plant was installed. It has been operating since July, 1940, at an over-all cost of $2.93 per 1,000,000 gallons of water treated. However, the use of ozone has made it possible to reduce the amount of chlorine and other chemicals required with the result that the net cost of ozonization is $1.99 per 1,000,000 gallons of water treated.

The Essential Auto

DURING a recent 5-day cessation of street-car and bus service in Detroit, business went on pretty much as usual and no manufacturing plant engaged in defense work was obliged to close. Those among the city's 1,600,000 residents who had to get to and from work, go shopping, or move about for any other reason, turned to private cars for transportation, and these handled the problem with amazing efficiency. Detroit is fortunate in that the ownership of private automobiles averages one car for every 3.7 persons.

The Detroit incident emphasizes the fact that passenger automobiles are no longer primarily used for pleasure. On week-ends and holidays, people still do much unnecessary motoring, but the average car is principally driven for purposes connected with earning a livelihood or with ministering to the economic and social necessities of the family. These statements are borne out by the results of surveys conducted by the Automobile Manufacturers Association. The findings were assembled from official records compiled by the U.S. Government and the highway authorities of several states. They show that the nation's cars amass an annual total of 498,000,000,000 passenger-miles of travel and make approximately 15,000,000,000 round trips. More than half the mileage and three-fourths of the trips come under the head of "necessity" driving. Ninety-six out of every 100 automobiles on the road are used a considerable part of the time for nonpleasure.

As a class, traveling salesmen cover the most ground, averaging 18,791 car-miles a year, or more than double the average per year for all drivers. Doctors are second, with an average annual mileage of 12,932, and they make the greatest number of round trips, 947. Farmers, industrial workers, and construction men are the leading owners of automobiles among occupational groups, but they make relatively short runs and their annual mileage is comparatively small. The 1940 census listed 4,731,159 cars owned by farmers, or 17 per cent of the total registered. The average farmer covers only 12.5 miles per trip and 5,750 miles a year. More than half the driving of cars by wage earners, who average less than 10 miles per trip, is classed as necessary, and two-thirds of the vehicles serve primarily to transport their owners to and from work. One-third of both farmers and wage earners covers less than 2,000 miles a year with necessity driving, and another third ranges between 2,000 and 4,000 miles. Nearly two-thirds of the cars used by wage earners are more than two years old, and 32 per cent of them are more than six years old. The survey shows that the older a car is, the less it is driven.

The Smoke Nuisance

WITH the approach of winter, urban communities in the northern latitudes are faced once again with the smoke problem. In addition to its unsightliness, smoke is deleterious to health and does untold damage to property. But, as is pointed out in the *Industrial Bulletin* of Arthur D. Little, Inc., the smoke nuisance can be abated. That was proved in St. Louis, formerly one of our smokiest cities, where the exercise of proper combustion techniques has rid the sky of its pall.

Contrary to popular belief, smoke from residences accounts for most of the murky veil over our municipalities. A smoking chimney is a sign of improper and wasteful combustion, and large industrial plants are quick to eradicate money-consuming practices. Householders could do the same thing by utilizing proper firing methods; but campaigns to educate them along these lines have been heeded little. Consequently, the attainment of domestic smokelessness rests, it has been decided, upon the use of either automatic stokers or smokeless fuels. Because automatic stokers are beyond the financial reach of a goodly proportion of the people, unoffending fuels would seem to be the best solution of the problem.

Marked progress already has been made along this line, and more than half the fuels now burned in domestic furnaces can be classed as smokeless. In the order of their utilization, these are: anthracite, fuel oil, natural gas, and coke.

They Collect Taxes Too

THE curfew on filling stations that has been in force along the Atlantic seaboard for several weeks has brought home to motorists the fact that they rely upon those outlets for many things other than gasoline. With only an occasional station open, the night driver now is somewhat of a pioneer, in that he may have to overcome road troubles through his own labor, resourcefulness, and mechanical ingenuity.

As a matter of fact, one-sixth of the dollars taken in by filling stations is in payment for goods or services exclusive of gasoline and oil, according to the American Petroleum Institute. In 1939, they furnished the traveling public with nearly $500,000,000 worth of auto supplies, grease and service jobs, food and beverages, overnight lodging, and miscellaneous other things.

Six out of every ten stations in the nation handle tires, batteries, radios, and similar articles; 52 per cent of them grease, wash, or service cars; and 39 per cent sell fuel oil or kerosene. In an undetermined percentage it is possible to obtain meals, soft drinks, groceries, and tobacco. The data refer to service stations proper, and do not include garages, parking lots, automobile agencies, and country stores that offer gasoline as a sideline. The average service station obtains 76 cents of every dollar of revenue from gasoline; seven cents from oil and grease; seven cents from auto supplies; 4½ cents from greasing, washing and servicing; one cent from fuel oil and kerosene; and 4½ cents from miscellaneous other sources.

This and That

Dowel Pin Mystery

A General Electric Company engineer was sent to the Belgian Congo to construct the first large electric plant in the region. He was instructed to complete his work in 90 days, so his first action was to check all the crates and boxes to see if everything he required was in them. His inventory disclosed one item missing—steel dowel pins. The camp was searched and the natives were questioned, but not a dowel pin was located. There was no time to order a duplicate shipment from the United States, so the engineer contrived to have some made out of scrap iron rods, using improvised tools and unskilled labor. He finished the plant on schedule and then returned home. Months later, a visitor to a half-savage tribe in the Belgian Congo was surprised to see men and women wearing a peculiar kind of nose ornament. Thrust through the nasal cartilage, gleaming and twinkling in the strong African sunlight, each native was proudly displaying one of the missing dowel pins.

* * *

The Day is Here

Seventy-five years ago the predecessor of the *Engineering and Mining Journal* published this item: "Compressed air, as a motor and medium for ventilating mines, has now been brought into practical and successful operation, and the day cannot be far distant when it will be in general use. Compressors are manufactured in this city (New York) with which a pressure up to 220 pounds is readily obtained." In that year, 1866, Charles Burleigh furnished the first of his piston-type rock drills for operation in the Hoosac Tunnel, modeling them after J. W. Fowle's drills which had previously been utilized in driving the Mont Cenis Tunnel through the Alps. The inventions of Simon Ingersoll and Henry C. Sergeant were still five years away, yet air compressors were in use. If the man that made the foregoing prediction could observe the present-day applications of compressed air he would be truly amazed. Not only in mining and allied lines but also in almost every conceivable industry does compressed air perform a multitude of services that has made it well-nigh indispensable.

IR
Robert Willyum

"Seen our ball, Mister?"

* * *

Inflated Duck Dinner

There is a Chinese restaurant in New York that serves many rare dishes—from the Occidental viewpoint. You can go there for your meal, or you can have it prepared and sent to your home. A 10-course mandarin dinner for six persons costs $10. The *piece de resistance* is roast duck, but it is not ordinary duck. Instead, it has undergone inflation, in the literal sense—that is, it has actually been pumped up. According to one who has seen such a fowl, "it is a thing of beauty, a rich even brown, without a seam or crack from prow to stern and as plump as the day it stepped out of the feeding pen, which is no accident. The dressed ducks are blown up like balloons with the aid of a bicycle pump. The air is forced between the skin and the body framework, then the skin opening is tied to hold the air in. After this, the duck is hung by a leg in a porkhouse barbecue, which is a sort of roasting oven that is as big as a closet and as native to a Chinese kitchen as are chopsticks. There the duck slowly roasts to a golden brown, taking on a wondrous tenderness and smoke-tinged taste."

* * *

Words We Don't Savvy

Some months ago the editor of *The Engineer*, esteemed British trade publication, was perplexed because he didn't know the meaning of "boondoggling." He feared that, in America, his name would be mud because every schoolboy would know something that he did not know. The word fascinated him, though, for he wrote: "How it fills the tongue and rolls in the vault of the mouth!" The editor was, of course, writing with his tongue in his cheek, for he quickly deduced that boondoggling is akin to the British "muddling through," and interpreted both terms to mean not planning in advance. He then discussed at some length the steps that the British were taking to eliminate muddled planning from the production of military airplanes.

Our reason for bringing all this up is that we, too, have word problems. We are stumped, for instance, by "paddy mails," which we found in an article of British origin that describes the use of flameproof diesel locomotives in coal mines. From the way in which the expression is used we know that it stands for some sort of underground haulageway. Its frequent recurrence in the article indicates that it is common in the British mother tongue; and it is obvious that there is a dash of Irish in the words. But they are neither in the dictionary (which does list boondoggling) nor in our glossary of mining terms, so we'll just go on wondering about them until someone enlightens us.

* * *

Mopping Brows Costly

In announcing a new lightweight, absorbent sweatband for industrial workers, the American Optical Company gives some rather startling statistics regarding the economic phases of perspiration. Time studies in a large foundry have revealed, it is claimed, that each operator of a chipping hammer or a grinder spends 42 minutes every day mopping his forehead and cleaning his goggles. Sweatbands that have appeared on the market in recent years are designed to eliminate such losses of time and also to increase the comfort of workers. An interesting angle is that sportsmen have adopted the new accessories which are now frequently seen on tennis courts and golf courses. Another aid to the perspiring workman is a material in stick form that can be rubbed on the lenses of goggles, masks, etc., to prevent fogging and steaming. After it is applied the surface is polished; and it is claimed that the material will remain effective for about twelve hours.

COMPRESSED AIR

Mr. Smithers hasn't had his picture taken with a small fish since he got his new outfit.

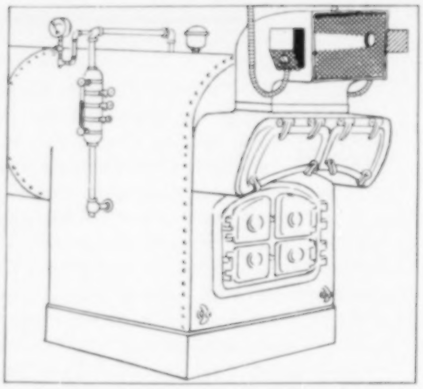
Cleaning Salvaged Airplane Engines

FOR cleaning engines salvaged from crashed airplanes, Rolls-Royce, Ltd., has designed and constructed a washing machine through which they, or quantities of component parts, are passed before reassembling or rebuilding. The machine is 33½ feet long, 10½ feet wide, and 12½ feet high. Placed in slowly moving swing carriers driven through reduction gear by a 2-hp. motor, the engines first go to a soaking chamber where they are immersed in a special solution at a temperature of 180°F. After 30 minutes they pass into the washing compartment where numerous jets, arranged around the wall so as to reach every part, shower them for six minutes with clean water, also at 180°, which is delivered at high pressure by a centrifugal pump. The pressure of the water at the nozzles is 22 pounds per square inch; but it can be boosted by compressed air if necessary. Finally, the engines are exposed for two minutes to blasts of compressed air to remove every trace of moisture. The machine is steam heated and temperatures are controlled by thermostats.

A similar unit is in use for the more exacting cleaning of airplane carburetor parts. This is built for both mechanical and hand washing, and for the latter purpose is equipped at the rear end with a special compartment fitted with an electric lamp, a glass panel, and two port holes through which the operator inserts his arms. Wearing long rubber gloves, he picks up each piece after it has received its initial bath in the washer and cleans it thoroughly inside and out by means of a high-powered nozzle operated by a hand grip. The same solution is used in both chambers and is filtered continually.

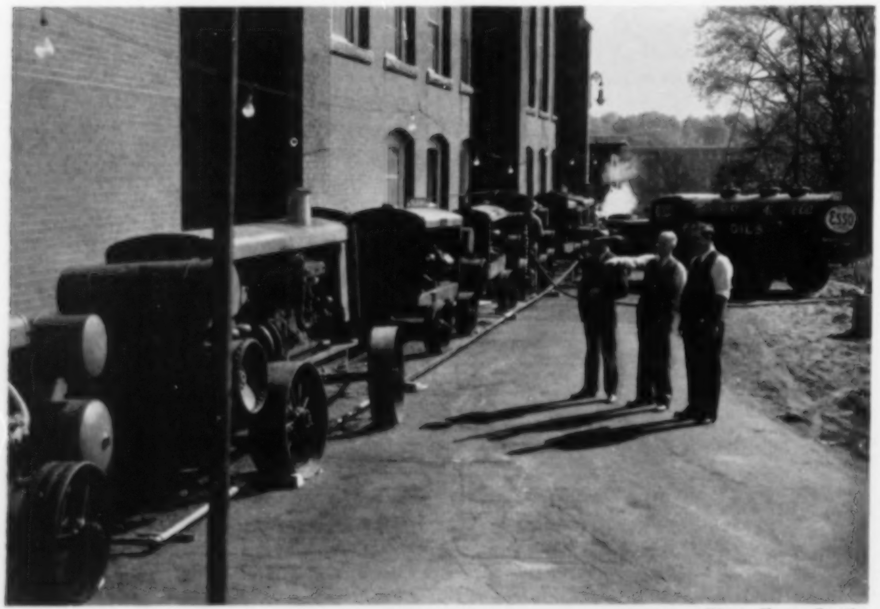
Smoke Arresters

MOST large cities have smoke ordinances; but that does not seem to prevent clouds of soot from polluting the atmosphere especially in industrial centers. To check the evil, which is the result of incomplete combustion of the fuel, the Rehtron Corporation has developed two moderately priced photoelectric units that can be installed on any type and size of boiler burning oil or any grade of coal fed by hand or stoker. One is an indicator-signal apparatus that gives the operator warning by bell or light, or both, the instant the smoke exceeds the maximum allowable density and enables him to take the necessary corrective steps. The other is an automatic smoke-control device that feeds steam and air, or air only, to over-fire jets as soon as the fire starts smoking excessively because of a deficiency in oxygen. The steam-air mixes with the unburned gases and is supplied in sufficient quantity to cause the smoke to be consumed in the firebox. It is claimed that the latter unit makes it possible to use coal of lower grade without loss in boiler efficiency and that it has shown fuel savings of as much as 20 per cent in the case of large and small boilers. Both models are operated with alternating or direct current of 115 volts.



ELECTRIC EYE ON GUARD

When the smoke in the breeching or stack exceeds the maximum permissible density, the intensity of the light beam of the smoke arrester (upper right) is reduced, causing the photoelectric cell to energize a relay coil which, in turn, rings a warning bell. In the case of the fully automatic system there is an additional circuit and relay which control a magnetic solenoid valve or a blower motor supplying air or steam and air in just the right proportion to burn the smoke in the firebox.



Photo, Eames Studio

PORTABLE COMPRESSORS MEET AN EMERGENCY

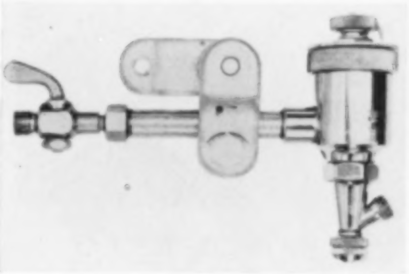
When a fire put out of commission the motor that drives the compressor furnishing fresh air for its humidifying system, the Chicopee Manufacturing Company, of Manchester, N.H., was faced with the apparent necessity of closing down for three weeks. Aside from the effect on production, it would have put 900 employees out of work. In this situation, Plant Engineer Dickey had an idea. "Why not," he thought, "rent portable compressors to tide the plant over the emergency?" Machinery dealers to whom he appealed rounded up nine portables, and they were hooked up as shown in the picture above. The units were operated 24 hours a day and answered the requirements of the textile mill until the regular equipment could be restored to service. In the background is a truck that made regular trips, night and day, to keep the compressors supplied with gasoline and oil.

Detecting Cracks in Crankshafts

AT THE General Electric Company's Works in Schenectady, N. Y., power presses, which are listed among the most hazardous of industrial machines, are periodically tested. This involves a variety of operations, including what is said to be a foolproof test for determining the condition of the crankshaft. This consists of magnetizing the shaft, making the direction of the flux longitudinal so that it will intercept any possible cracks at right angles. While magnetized, the shaft is sprayed with kerosene carrying in suspension finely divided particles of magnetic iron oxide. Any cracks or discontinuities in the metal will set up magnetic poles which, while very slight, nevertheless are strong enough to attract and hold the iron oxide, thus outlining the flaws and revealing even those that are not visible to the naked eye under ordinary circumstances. The test is made each time a shaft is removed from a punch press because the former is subjected to tremendous strain in service. One large company recently examined a group of 43 crankshafts in this way and found that fourteen of them were cracked and required replacement.

Industrial Notes

Air guns for spraying lubricants containing dispersions of colloidal graphite have been made available by the Paasche Airbrush Company. They are designed to lubricate working surfaces automatically and intermittently and are equipped with a universal mounting by which the unit can be quickly adjusted to any desired position or angle to assure uniform coverage. According to the manufacturer, the pneumatic piston that controls the spraying action can be started and stopped almost instantaneously, making it possible to regulate closely the amount of lubricant applied with each shot and to deliver as many as 150 a minute. Compressed air at a minimum pressure of 35 pounds is used; and by means of a double-acting valve the air is turned on before the fluid needle valve opens and continues to flow until after the needle is seated, thus assuring complete atomization of the colloidal-graphite carrier. The guns can be furnished with any one of three sizes of associate equipment for light, average, or fast application, as well as with different sizes of multiple heads adjustable for fan or cone spray and suitable for colloidal graphite carried in oil or water, or for low-viscosity carriers such as kerosene, carbon tetrachloride, etc. In the case of the latter, the carriers evaporate, leaving a "dry film" of graphite. They are recommended for use where high temperatures render liquid lubricants ineffectual.



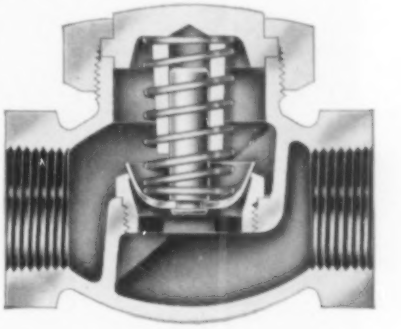
Gold production in Canada has mounted from 2,102,100 fine ounces in 1930, worth $43,453,600, to 5,322,900 ounces in 1940, worth $204,930,000. This represents an increase in quantity of two and a half times and in value of between four and five times.

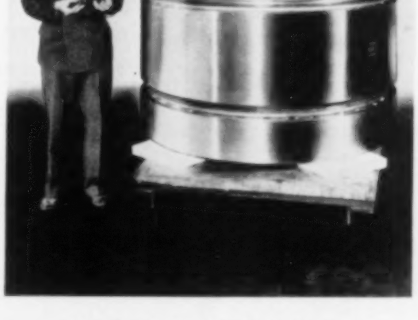
How to eliminate fitting and tubing failure due to vibration or tube movement in mechanical equipment is the subject of a 16-page bulletin recently issued by The Imperial Brass Manufacturing Company. It is pointed out that there are three major kinds of tube movement in lines used to carry liquids or gases to automobiles, airplanes, trains, tanks, machine tools, and the like. These are classified as minor vibrations, major vibrations, and tube movement. Each is defined, and the prevention of tubing and fitting failure in each case discussed. Complete listings of three different types of fittings from 1/8 to 3/4 inch outside diameter are given, and tools for tubing-connection work are described. Copies of Bulletin No. 3101 can be obtained by writing to the manufacturer, 1200 W. Harrison Street, Chicago, Ill.

In the new self-winding hose reels manufactured by the M. & H. Hose Reel Company, the reel is turned by a coil spring through gear drive or, in case of extra-long lengths, by an air cylinder. Packing-gland troubles are eliminated, it is said, by the use of a patented self-sealing, ball-bearing rotary joint.

The new Ford aircraft engine plant at Dearborn, Mich., has a bombproof roof of reinforced concrete 22 inches thick, and electrical conduits are safeguarded against air attack by a 12-inch layer of steel and concrete. According to studies made in England, bombs of the type now in use cannot penetrate these defenses.

Jenkins Brothers has announced its new Air Compressor Check Valve—Figure 56—that is claimed to be radically different from others of its kind in design, seating principle, and operation. As the accompanying longitudinal section of the valve shows, the disk is conical in shape and has a narrow seating surface. The result is a self-cleaning action that keeps the seating surfaces free from carbon and other deposits. On the upstroke the disk is cushioned by the spring, which gives the downstroke sufficient impetus to assure a bubble-tight closure. The removable seat ring, the stem, and the disk affixed to it are made of a stainless-steel alloy that is said to be so strong that a wafer-thin sheet is used to form the disk, thus making it light in weight and quick-acting even under light pressure. The body of the valve is of high-tensile bronze and is provided with a cap of the union type for easy access. Jenkins Figure 56 Valve is available in sizes ranging from 1/4 inch to 2 inches and for air pressures up to 300 pounds per square inch.





STRIKING CONTRASTS

Here are the smallest and the largest tapered roller bearings ever made by The Timken Roller Bearing Company. The little one, which the man is holding, has a bore of 0.375 inch, an outside diameter of 1.2595 inches, and a width of 0.394 inch. It is used in automobile generators. The big one has a 35½-inch bore, an outside diameter of 51 inches, and is 36 inches wide. It is one of four on the back-up rolls of the new 4-high reversing hot mill of the Aluminum Company of America.

Mitts is the name of a water-soluble hand cream that is applied before starting work. It is said to dry quickly, covering the hands like a glove and protecting them from grease, paint, and ink, as well as many irritating materials which cause industrial skin diseases. It is easily removed by washing, taking all dirt with it.

Loose bolts, nuts, and shavings in bombing planes are removed in one plant by suction. The special vacuum hose used for this purpose has a smooth bore to facilitate passage of the material and is light and flexible so that it will stand up under the many turns and bends it has to make to reach every part of the aircraft.

Night maintenance crews of the East Bay Municipal Utility District of Oakland, Calif., are provided with trouble-shooter trucks that are painted white as a safety measure. They carry special lights, a compressor, pneumatic tools, and other equipment suitable for repairing any kind of breakdown in the water-supply system.

According to a recent issue of *Foreign Commerce Weekly*, a Chinese chemist has discovered a means whereby wood oil can be used instead of water for the recovery of gold by washing. It is claimed that tung oil has been successfully employed for the purpose and that the added cost incurred as a result is more than offset by the higher gold yield.

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2	3	50	200	200
2½	3⅝	50	200	272
3	4¼	50	200	340
4	5⅜	50	200	450

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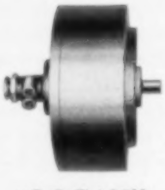
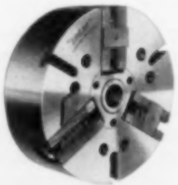
AIR CHUCKING AS APPLIED TO GISHOLT HYDRAULIC AUTOMATIC LATHE



"LOGAN" Model R Air Cylinder



"LOGAN" Model 350-B Chuck

This Gisholt No. 12 Hydraulic Automatic Lathe is equipped with a 12" diameter "LOGAN" Model 350-B Three Jaw Chuck and a Model R Rotating Type "LOGAN" Air Cylinder. The "LOGAN" Chuck is designed to provide extra power and exceptional jaw rigidity in heavy duty chucking service. The "LOGAN" Double Acting Air Cylinder has a 10" bore and 1¼" stroke and is designed for the economical operation of air chucks required to be mounted on a revolving spindle. This heavy duty "LOGAN" equipment assures positive chucking and operating efficiency. "LOGAN" Representatives and "LOGAN" Engineers will be glad to make recommendations on your chucking problems.

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A Handbook on Pneumatic Engineering and Related Subjects

by F W. O'Neil
Member A.S.M.E., A.I.M.E., American Mining Congress, Mining and Metallurgical Society.

125,000 COPIES IN USE!

This 408-page book on the theory and practice of compressed air engineering has been entirely rewritten, rearranged, and enlarged to meet today's needs of industry.

You cannot afford to be without a copy. You will find yourself referring to it daily. It has long been known as the "Bible" of the industry. It covers the subjects in which every owner and user of pneumatic equipment is interested.

The editor has avoided the formality usually associated with books of this kind. Terms, definitions, and practices are handled in a style readily understood by the non-technical reader. Numerous theories and tests are discussed and accompanied by scientific data, tables, curves, and formulae of great value to engineers and students.

Eighteen pages of cross index enable the user to quickly locate any required data. PRICE $ 3.00

Book and Periodical Bureau, Compressed Air Magazine Co.
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- does not apply to the Cycoil

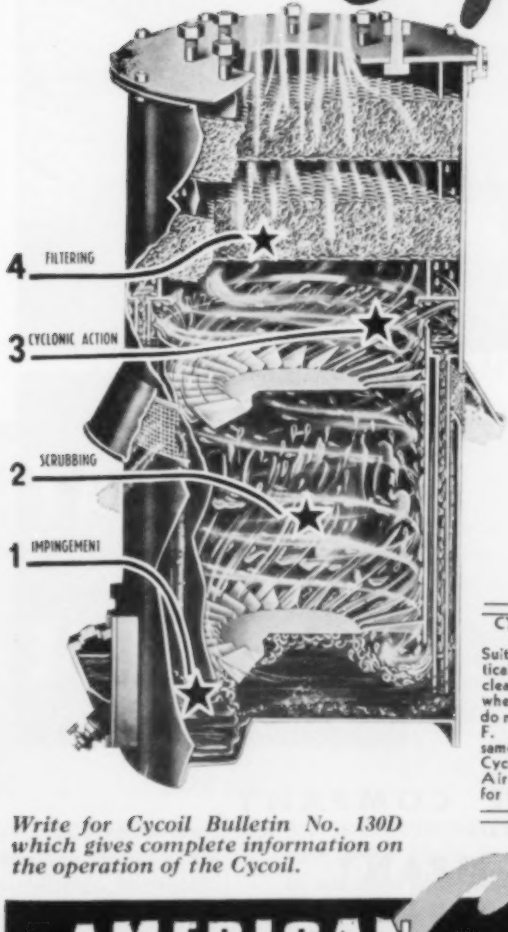
Judged by Performance Cycoil Cleaners have no equal . . . .

Its exclusive 4-way cleaning, assures positive dust elimination under the most exacting conditions. In addition to its outstanding performance as an air cleaner the Cycoil is also effective as an intake silencer on either engines or compressors.

Engine manufacturers know the Cycoil and its exclusive advantages. If you specify them they will gladly equip your new engines with Cycoils.

Write for descriptive literature on all types of American Air Filters for engine and compressor protection. AAF manufactures a complete line of filters for every air cleaning need.

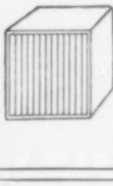
AMERICAN AIR FILTER CO., INC.
INCORPORATED
203 Central Avenue, Louisville, Ky.



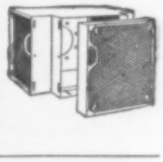
Write for Cycoil Bulletin No. 130D which gives complete information on the operation of the Cycoil.

CYCOIL GAS CLEANER
Suitable for practically every gas cleaning problem when temperatures do not exceed 140° F. Operates on same principle as Cycoil Oil Bath Air Cleaner. Ask for Bulletin 130D.

PL-H FILTER
is a complete assembly consisting of housing, ready to bolt to intake pipe, and dry cell type filters in which wool felt constitutes the filter medium. Ask for Bulletin 120D.

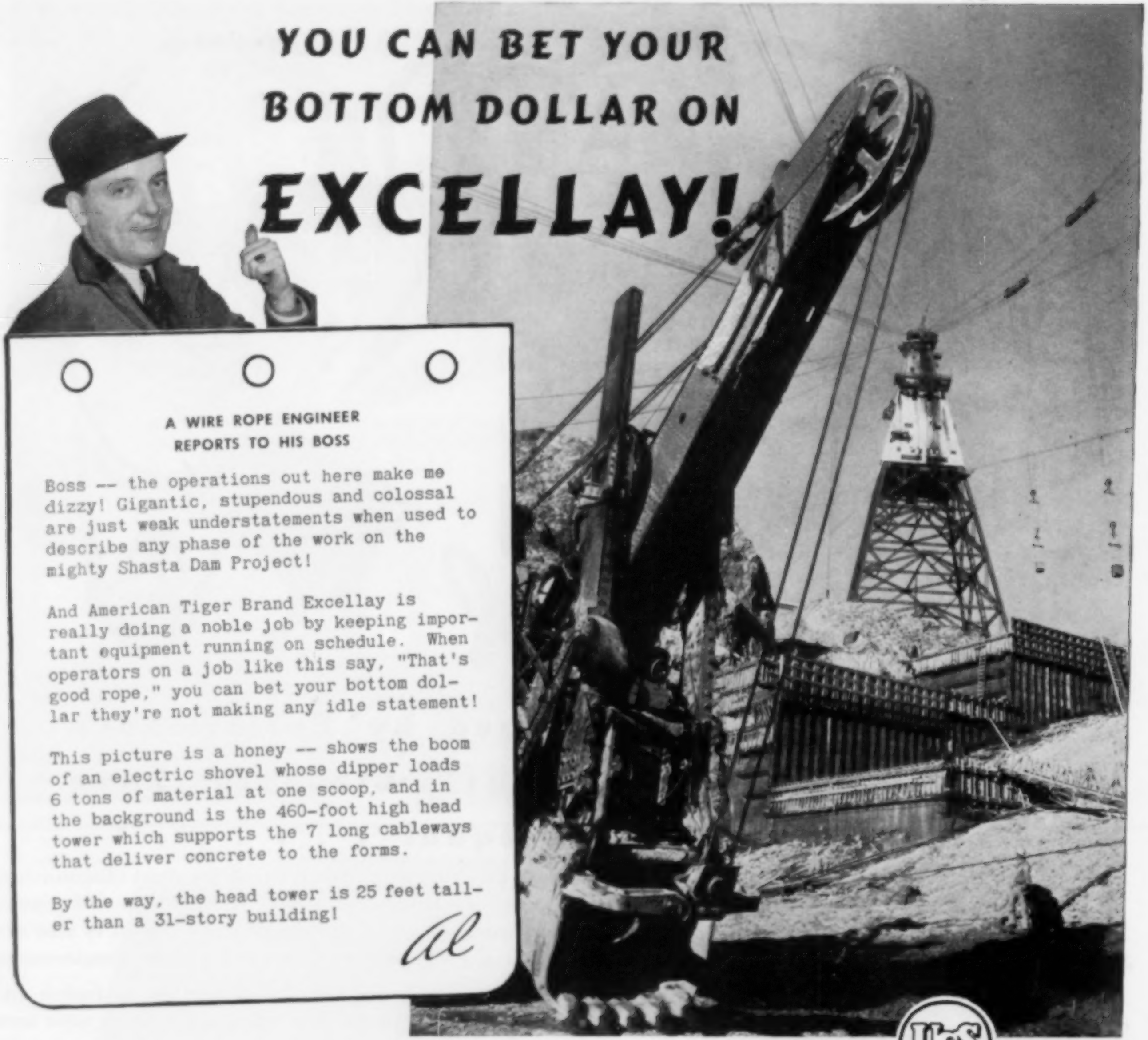


TYPE OCH FILTER
Complete essembly consisting of washable viscous impingement type filters. 1, 2, 3, or more cells are used depending upon size of cleaning job. Ask for Bulletin 120D.



AMERICAN Cycoil AIR and GAS CLEANERS

YOU CAN BET YOUR BOTTOM DOLLAR ON EXCELLAY!



A WIRE ROPE ENGINEER REPORTS TO HIS BOSS

Boss -- the operations out here make me dizzy! Gigantic, stupendous and colossal are just weak understatements when used to describe any phase of the work on the mighty Shasta Dam Project!

And American Tiger Brand Excellay is really doing a noble job by keeping important equipment running on schedule. When operators on a job like this say, "That's good rope," you can bet your bottom dollar they're not making any idle statement!

This picture is a honey -- shows the boom of an electric shovel whose dipper loads 6 tons of material at one scoop, and in the background is the 460-foot high head tower which supports the 7 long cableways that deliver concrete to the forms.

By the way, the head tower is 25 feet taller than a 31-story building!

Al

A GOOD way to get good service out of your wire rope is to take full advantage of the wide experiences of American Tiger Brand Wire Rope Engineers. Our field engineers are interested in seeing that you get a full dollar's value out of every dollar you invest in wire rope. That's why you'll find them right out where the rope is used—that's where they spend most of their time. There's no better place to keep in touch with wire rope performance.

These engineers are well qualified to give you exactly the service you need—speedily, too! Besides helping you to select the most practical wire rope for a particular job, they can often give you valuable, money-saving tips on operation. And there's no obligation.

American Tiger Brand Wire Rope is made in all constructions and grades. Call on one of our engineers to help you specify the types best suited for your job.

EXCELLAY
Preformed
WIRE ROPE

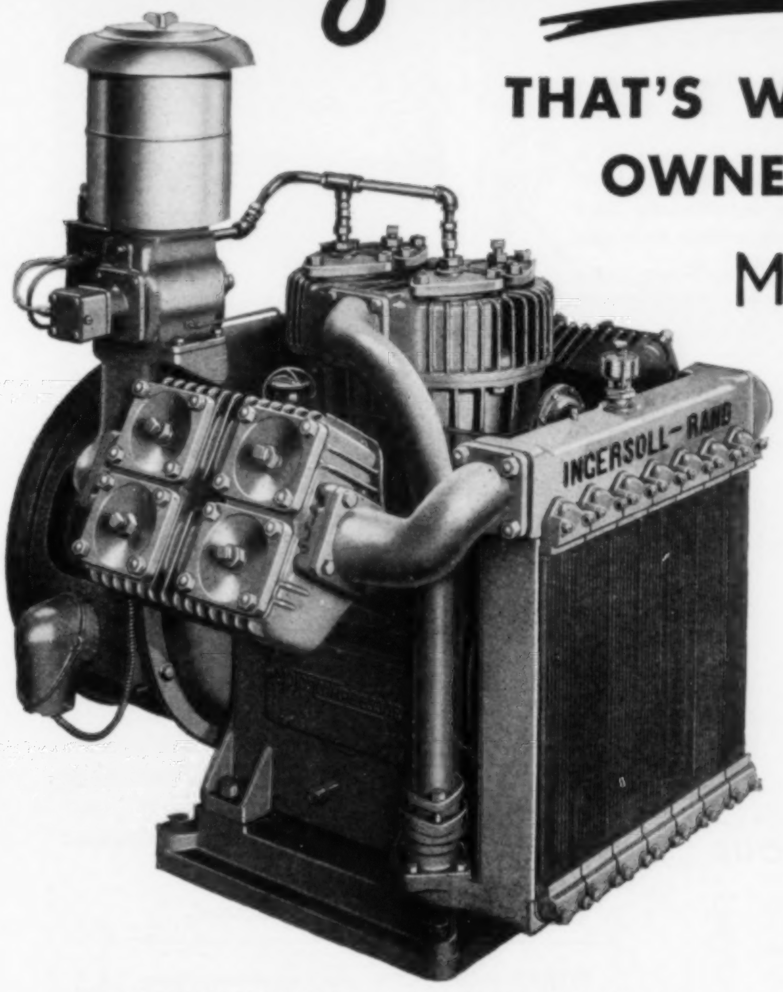
AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York

UNITED STATES STEEL

"—doing a remarkable job"

THAT'S WHAT HUNDREDS OF OWNERS SAY ABOUT THE

MOTORCOMPRESSOR



The MOTORCOMPRESSOR has a built-in electric motor. Other models are direct-coupled or are V-belt driven from motor or engine.

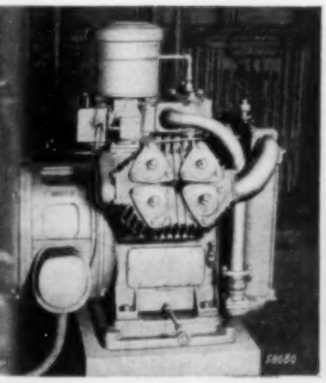
ENGINEERS who have been operating heavy, horizontal compressors are always amazed at the performance of the modern Two-Stage Air-Cooled Type 40 Compressor.

Though compact and light in weight, the Type 40 has such quality features as two-stage compression, die-forged crank-shaft and connecting rods, Timken tapered-roller bearings, Channel Valves and precision manufacture throughout. Combined they assure high operating efficiency and reliability.

Because of its automatic lubrication and regulation features it requires but little attention.

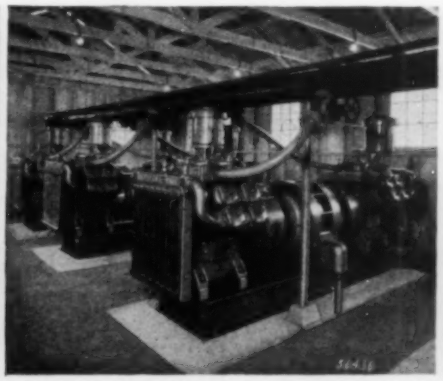
If you need a compressor of from 60 to 400 cfm capacity, you can't afford to overlook the Type 40. Ask for Bulletin 3166-A.

Type 40's Solve Air-Compressor Problems Like These:

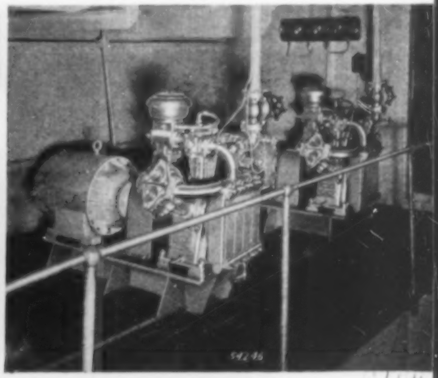


- **COMPACTNESS was necessary in this eastern railroad terminal. A 50-hp Motorcompressor was installed.**

- **NO COOLING WATER. This Type 40 is installed in an unheated shed. Being air-cooled, it cannot freeze up.**



- **EASY TO RELOCATE. This construction job used Type 40's because they could be temporarily installed on an inexpensive foundation.**



- **LIGHTWEIGHT units are necessary aboard ship. This pair of 15-hp Type 40 compressors supplies service air for a tanker.**

1-80

Ingersoll-Rand

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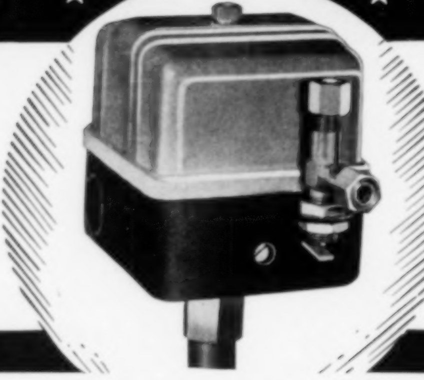
AN ACCEPTED STANDARD ★ ★ ★



CLASS 9210 TYPE A3 PRESSURE SWITCH

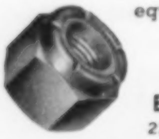
For the garage type air compressor, ratings up to 1½ H. P. 110 V, 2 H. P. 220 V single phase and 3 H. P. 220 V polyphase, use the 9210-A3. The pressure limit is 200 lbs., adjustable range and differential. Direct connection to release valve without fittings. Priced right.

SWITCH—PROTECT—REGULATE . . . DO IT ALL WITH SQUARE D

SQUARE D COMPANY • REGULATOR DIVISION • DETROIT

600 MILES PER HOUR • STRAIGHT DOWN

It is such tests as this that prove the ability of Elastic Stop Nuts to hold tight under all combinations of vibration, shock, and stress. These self-locking nuts are used on all American military and transport airplanes . . . and on widely diversified industrial equipment . . . for safety and economy.



» Write for folder explaining the Elastic Stop self-locking principle.

ELASTIC STOP NUT CORPORATION

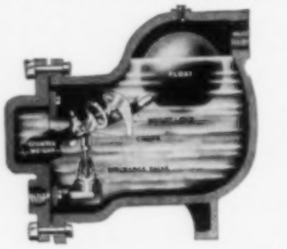
2359 VAUXHALL ROAD • UNION, NEW JERSEY

Elastic Stop SELF-LOCKING NUTS

MODEL JR

"NICHOLSON"

COMPRESSED AIR TRAP



For automatically draining water and oil from Air Tanks, Receivers, After-Coolers, Separators, etc. Valve always water sealed. Quick snap action—Made in one size with ½", ¾" or 1" inlet and ½" outlet—Good for pressures up to 125 lbs.

Bulletin No. 341 on request.

OTHER PRODUCTS: Air Separators, Steam Traps, Flexible Couplings, Expanding Mandrels, Steel and Stainless Steel Floats, 3 & 4-Way Air Valves for single and double acting cylinders.

W. H. NICHOLSON & CO.

165 Oregon Street,
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—right from the start for—

BASIC ELECTRIC STEEL FORGINGS

NF

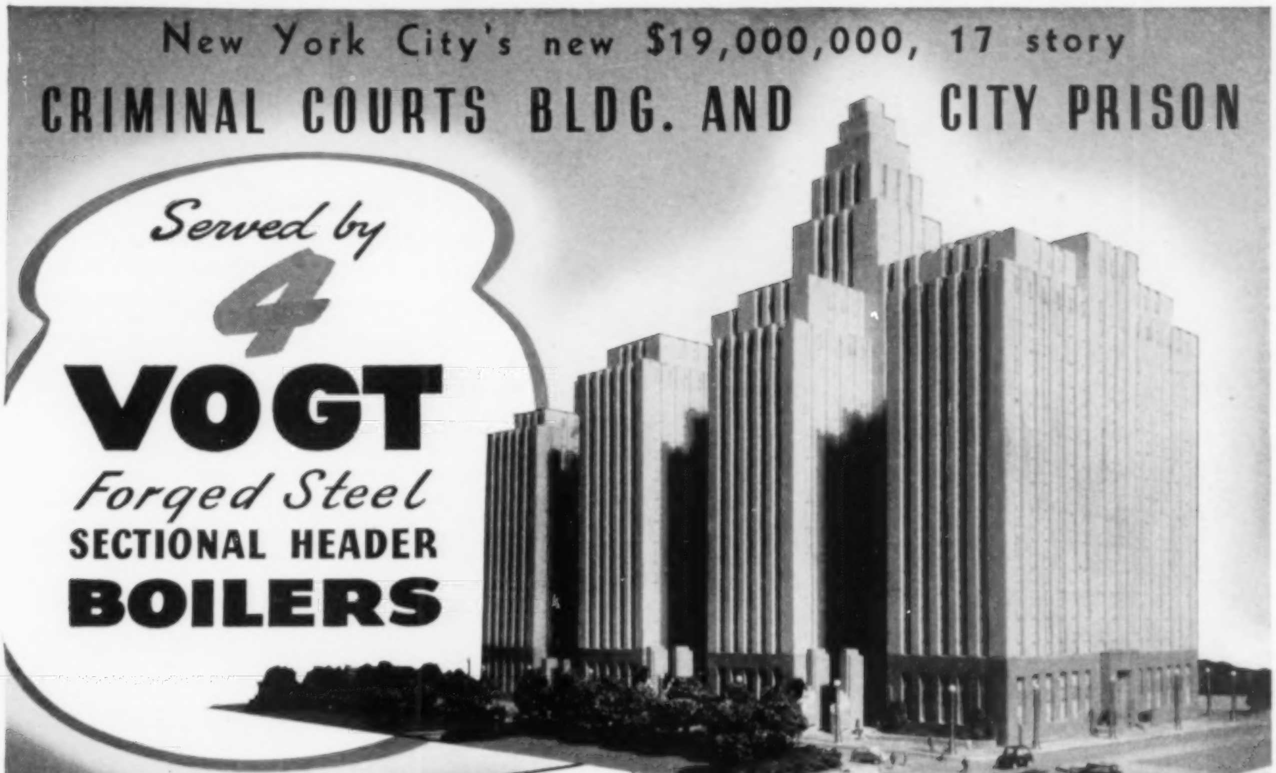
COMPLETE control of all processing from selection of the melting charge to the finished condition is the N. F. & O. *guarantee of quality* in forgings furnished to your specifications–Smooth Forged, Hollow Bored, Rough or Finished Machined.

NATIONAL FORGE & ORDNANCE CO.

IRVINE, WARREN COUNTY, PENNA. U. S. A.

New York City's new $19,000,000, 17 story

CRIMINAL COURTS BLDG. AND CITY PRISON



Served by

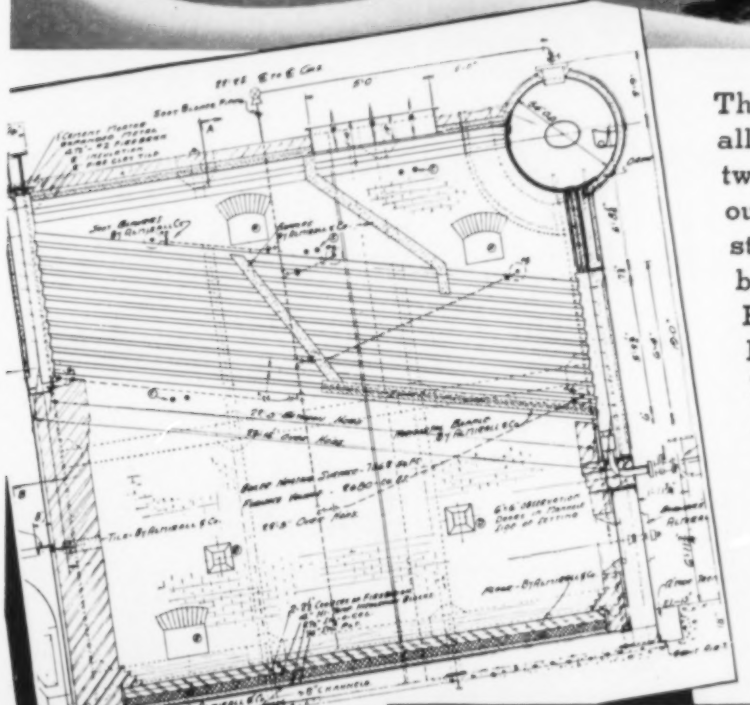
4

VOGT

Forged Steel

SECTIONAL HEADER

BOILERS



Thirty Court Rooms and Jury Rooms, all completely air conditioned, and a twelve story Prison are housed in this outstanding Public Building. All the steam requirements will be supplied by four Vogt Sectional Header Boilers.

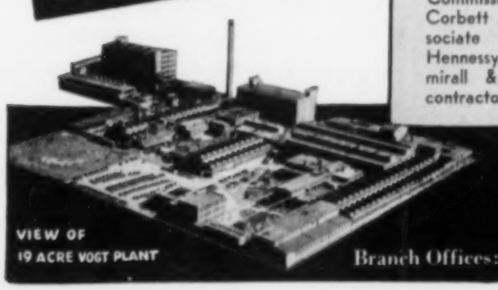
Each steam generating unit has 7,062 sq. ft. of heating surface designed to generate 47,000 pounds of steam per hour at 200% rating, using oil for fuel. Headers, forged from seamless steel tubing, and the fusion welded steam drum are designed for 200 pounds working pressure.

●

Designed and constructed under the supervision of the Department of Public Works, Irving V. A. Huie, Commissioner, with Harvey Wiley Corbett and Charles B. Meyers, associate architects, and Syska & Hennessy, consulting engineers. Almirall & Company, Inc., heating contractors.

Vogt builds steam generating equipment in many types and sizes to meet every heating, power, or processing requirement.

Vogt
FOR BETTER BOILERS

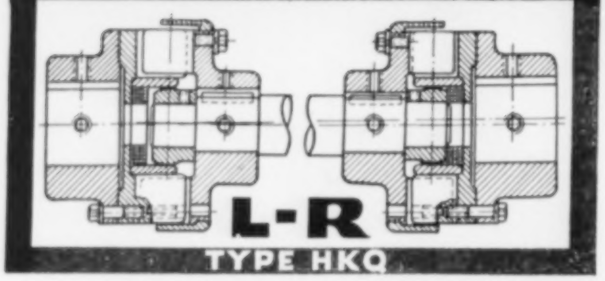


VIEW OF
19 ACRE VOGT PLANT

HENRY VOGT MACHINE CO., Inc.
LOUISVILLE, KY.

Branch Offices: *New York - Philadelphia - Cleveland - Chicago - Cincinnati - St. Louis - Dallas*

Outstanding Advance *in* FLEXIBLE COUPLING!



TYPE HKQ

New FLOATING SHAFT TYPE

LOVEJOY announces a **new** L-R Flexible Shaft Coupling, successfully meeting all problems of angular or parallel misalignment—even the most extreme. Applicable to either horizontal or vertical drives. Covers **longer distance** drives where ordinary couplings fail. Quickly disassembled. Standard sizes with bores from 1½ in. to 8½ in., and for various distances.

There is an L-R Coupling for practically every flexible coupling demand you have to meet. NO LUBRICATION REQUIRED. Install L-R Flexible Couplings for a new experience in smooth handling of shock loads and misalignment.

Send for new complete catalog and selector charts. Free for the asking.

LOVEJOY FLEXIBLE COUPLING CO.

4951 W. Lake Street **Chicago, Illinois**

RICHMOND Form-Tying Methods for Concrete Work are Hours Ahead of Profit-Eating "Make-Shift" Devices!

You could puddle your concrete, right on the job, but you don't! Why, then, struggle through your concrete form work with methods equally old fashioned? You don't have to!

Richmond patented pre-fabricated form-tying devices are specifically engineered for tying and anchoring concrete forms of every kind — from light walls to heavy structures. Richmond products save money, save time, do a better job. Prove it? Gladly! Just ask.

RICHMOND 10-WAY PROFIT PLAN

① —Over 60 different form-tying devices meeting every condition. ② —Cost less to use than usual "Home-Made" wire, band or rod tys. ③ —Engineered for safe working loads of 1500 to 25000 lbs. ④ —Faster erecting and stripping saves time and lumber. ⑤ —Promotes perfect wall alignment, plus uniform thickness. ⑥ —1 to 2 inch "hold back" protects job against rust staining. ⑦ —Weight scientifically cut to save shipping and handling costs. ⑧ —Delivery right to the job saves warehousing. Job section labels save time. ⑨ —No cost for working parts. You pay only for tys used. ⑩ —Job planning bureau specifies types, quantities, methods, free.

FASTER FORM WORK!

See point 4. Because Richmond specifies, supplies, and shows you how, there is no waste of time, money or materials. Your job goes faster. Your profits bigger.

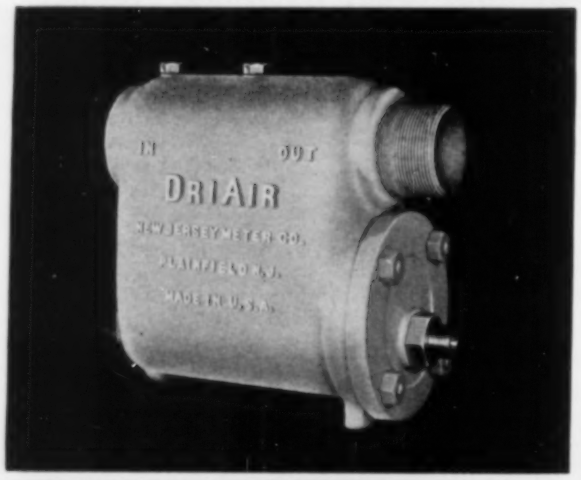
11 pages of buying data for Architects, Engineers, Builders, Contractors.

SEE OUR CATALOG IN SWEET'S

RICHMOND SCREW ANCHOR COMPANY, INC.

816 LIBERTY AVENUE, BROOKLYN, N. Y.

GREATER PNEUMATIC EFFICIENCY



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

● DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

Write for Bulletin DA which fully describes the construction and operation of the DriAir.

DriAir may be suspended from overhead piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

SEPARATES • COLLECTS • DELIVERS

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

ANNOUNCING–

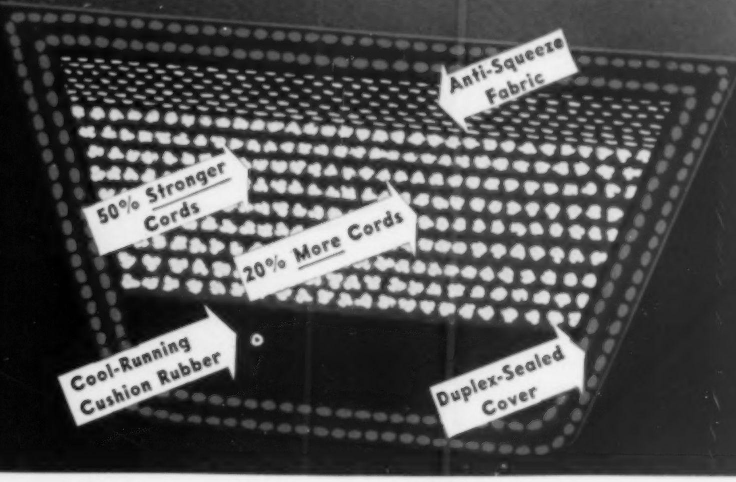
50% MORE CORD STRENGTH IN NEW TEXROPE SUPER-7!

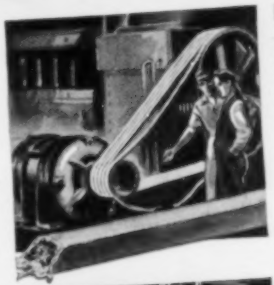
1 50% STRONGER CORDS! Sensational new Flexon process makes cords 50% stronger than even those in former great Texrope belts.

2 20% MORE CORDS! Count them! You get 20% more of these tough, extra pulling power cords in every Texrope Super-7.

3 INCREASED LIFE! Cords float on amazing cool-running cushion rubber that absorbs shock . . . actually increases belt life phenomenally.

4 EXTRA PROTECTION! Exclusive duplex-sealed cover protects pulling cords against dirt, grit, moisture, and other adverse elements.

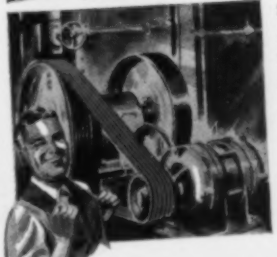




LOOK OUT FOR DANGER in belts with stiff, unpliable cords! Such belts *look* strong . . . but actually they buckle over sheaves, build up excessive heat that attacks pulling cords. Result: Belt failure far sooner than you expect it.

WARNING SIGN!

Sagging, slipping belts mean too much stretch not backed up by balanced cord strength. Motor must be pulled back often to take up slack. Result: When stretch limit is reached belt breaks under tension.



SUPER-7 TEXROPE BELTS are made by amazing Flexon process that *combines* flexibility with low stretch . . . great strength. Cords float on cool-running, shock absorbing cushion rubber. Result: *true* strength . . . *true* pulling power . . . *true* endurance.

A1435

DISCOVERED! A new way to make load-carrying V-belt cords — the Flexon process!

In this amazing new method, the cords are made smaller . . . and 50% stronger. And because they are smaller, 20% more of them are used in each belt.

That's the big news behind the new Texrope Super-7 V-belt. But that's not all the news —

For in this new belt we use a new special heat-resisting rubber compound that acts as a cushion to absorb operating shocks and dissipate internal heat. And we wrap the belt in a new "duplex-sealed" two-ply cover for extra protection against dirt, moisture, and other destructive elements.

Added up, these four-fold advantages mean you get *more pulling power . . . greater resistance to excess stretch . . . and much longer life in Super-7 than in any belt you ever heard of.*

We want you to know all about Super-7 V-belts. We want you to try them. For here are belts *that are better* . . . and *they cost no more!*

For the complete story about Super-7, call the Texrope dealer near you . . . or the Allis-Chalmers district office in your neighborhood.

Available in All Sizes —
½ hp to 2000 hp.

*Trade mark registered U. S. Patent Office. Texrope Super-7 Belts are the result of the co-operative research and design genius of *two* great companies — Allis-Chalmers and B. F. Goodrich — and are sold exclusively by Allis-Chalmers.

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

Modern Ingersoll
Equipment is inc
production in mines
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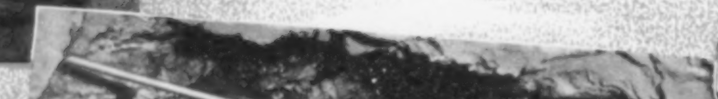
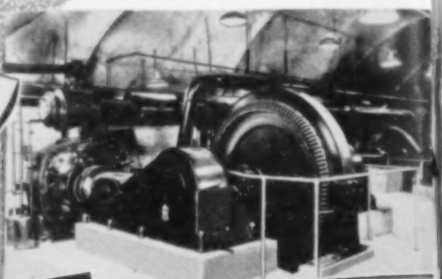
JACKHAMER


DRIFTERS

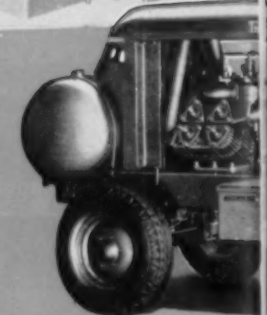
JACKBIT

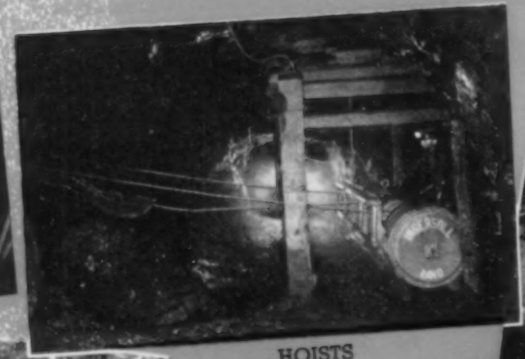
ELECTRIC-DRIVEN COMPRESSORS



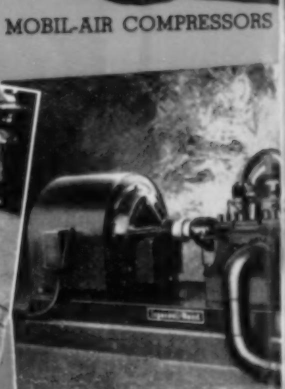
STOPEHAMER

MOTORCOMPRESSORS

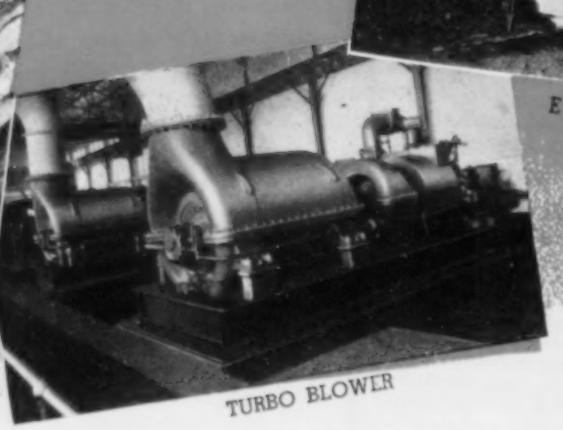

MOBIL-AIR COMPRESSORS


HOISTS

ES COMPRESSOR



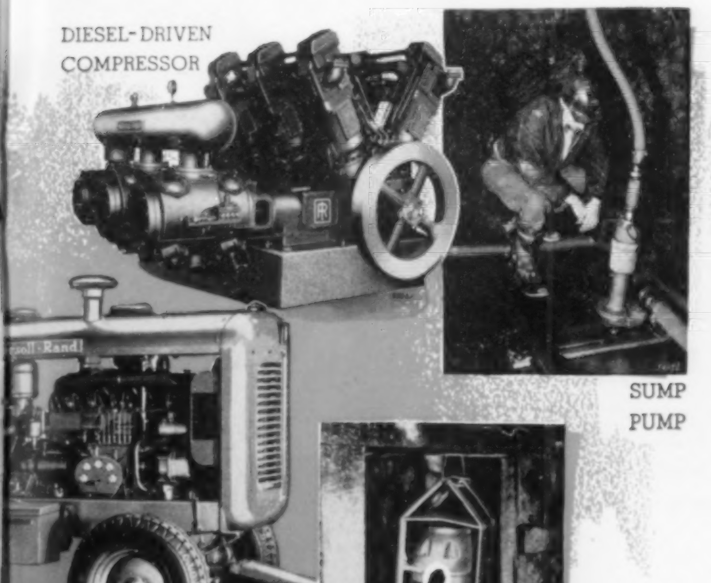
CORE DRILL


TURBO BLOWER

JACKLEG

THREE-QUARTERS OF A CENTURY OF

-Rand
reasing
through-



DIESEL-DRIVEN COMPRESSOR

SUMP PUMP

SHAFT SINKING PUMP

STAGE
RT STATION
PUMP

DIESEL ENGINE

THERE IS A REAL BACKGROUND OF EXPERIENCE BEHIND EVERY PRODUCT

In 1866, the mining industry first recognized the dependability and durability of Cameron pumps. The old Cameron slogan, "Character is the Grandest Thing" is still known to mining men everywhere. The Ingersoll-Rand Company carries on this tradition. A full line of modern I-R pumps serves the ever-increasing needs of industry.

When Cameron pumps were originated, no one had solved the problem of drilling rock economically, but mining men and contractors recognized the need for such a machine. We quote from an editorial in the first issue of the American Journal of Mining: "We must seek out and set to work the best machinery for drilling the rock and cutting the coal." In 1871, Simon Ingersoll built the first practical rock drill. It was the first to embody the independent valve motion, the variable piston stroke, and an automatic feed attachment. The intervening years have shown that it marked a definite milestone in the progress of civilization, because it greatly reduced the cost of drilling rock, thus permitting the development of mines and quarries everywhere. It ushered in a new era of modern highways, bridges, buildings, subways, tunnels, waterworks, and many other projects that contribute so much to our everyday life.

This policy of pioneering and developing is as real throughout the I-R organization today as it was when started by Cameron and Ingersoll. Pioneers such as Sergeant, Rand, Leyner and a score of others have kept Ingersoll-Rand drills in the forefront, year after year, and we intend to see that as the decades pass, they continue to lead in practical worth. Performance on many recent mining and construction jobs attest to this.

Jackbits cut drilling costs from 10 to 40%; modern I-R compressors in all types and sizes supply low cost air; there's an economical pump for every mining need. I-R scraper hoists reduce mucking costs; Type S Diesels furnish dependable power, and the efficiency of our Blowers makes them ideal for ventilation, blast furnaces, Bessemer converters, copper converters, agitation, etc.

Ingersoll-Rand
11 BROADWAY, NEW YORK CITY

Branches or Distributors in principal cities the world over.

14-71

Progress **IN THE MINING INDUSTRY**

SEE HOW YOU

WITH THE

Extra Convenience Features

HELP YOU GET THE TRI-CLAD MOTOR INTO SERVICE FASTER . . . KEEP IT IN SERVICE WITH LESS ATTENTION.

Easy to Handle ▶

1. They can be moved into position easily because of their light weight and compactness. The shape of the bearing housings and the location of end-shield fittings make it easy to handle Tri-Clad motors with slings. In addition, they are sturdily built and do not have to be coddled.

Quickly Mounted or Altered ▶

2. Their feet are machined accurately and drilled for standard mounting bolts. The reversible stator puts the roomy conduit box on the most convenient side and the end shields can be rotated to any of four positions to meet mounting requirements.

◀ Simple to Align

4. Accurate alignment, with the minimum of shimming, is afforded by their rigid, cast-iron frame construction, close machining tolerances, and accurate milling of feet. Pinions, pulleys, or couplings can be properly fitted because of close machining of the shaft extension and convenient shoulders on the shaft.

◀ Convenient to Lubricate

5. Tri-Clad motors have a large oil or grease capacity. On sleeve-bearing motors, the oil-filler gage can be located on either side of the bearing housing. A spring cover on this gage permits quick checking of the oil level. On ball-bearing motors, a pressure-relief greasing system assures rapid and thorough greasing.

BUILT FOR PROTECTION FIRST . . . TO LAST

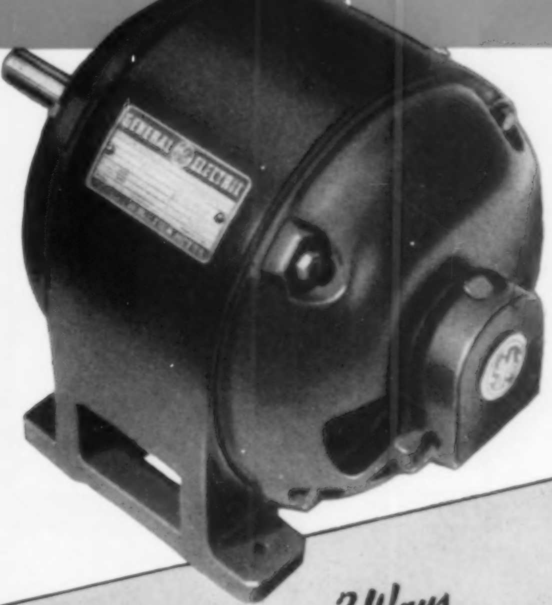
SAVE TIME

TRI/CLAD MOTOR

REG. U. S. PAT. OFF.

Easy to Wire ▶

3. A large, four-position conduit box gives unrestricted working space. It can be quickly removed for wiring. Flexible leads are pressed on the terminals, which are permanently identified. No soldered connections are necessary. A stainless-steel, graphic connection plate is conveniently located on the conduit-box side of the motor.



Extra Protection 3 Ways

HELPS ASSURE LONG SERVICE LIFE

Production interruptions are avoided and operating time is saved when the motor you buy can stand up under the many adverse operating conditions commonly found in industry. Tri-Clad motors meet these conditions with—

1 *Extra Protection* **against physical damage**
2 *Extra Protection* **against electrical breakdown**
3 *Extra Protection* **against operating wear and tear**

Write for Bulletin GEA-3580, which gives full details of these extra protection features and other Tri-Clad motor advantages.

◀ Easy to Clean

6. The smooth, rounded contours of the Tri-Clad motor—with the upper portion completely enclosed—have few recesses or projections to catch and hold settling dust. Such dust as does settle on the motor can be readily wiped away with a cloth or piece of waste.

THE new General Electric Tri-Clad motor is a cinch to install. Its convenience features pay off in precious minutes saved—both for those who build motors into machines and for those who use them in the plant.

Next time you order motors, take *time saving* into account, along with protection and performance; make sure you get Tri-Clad motors—now available in a wide range of types and integral horsepower sizes to 20 hp. General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

750-82-8058

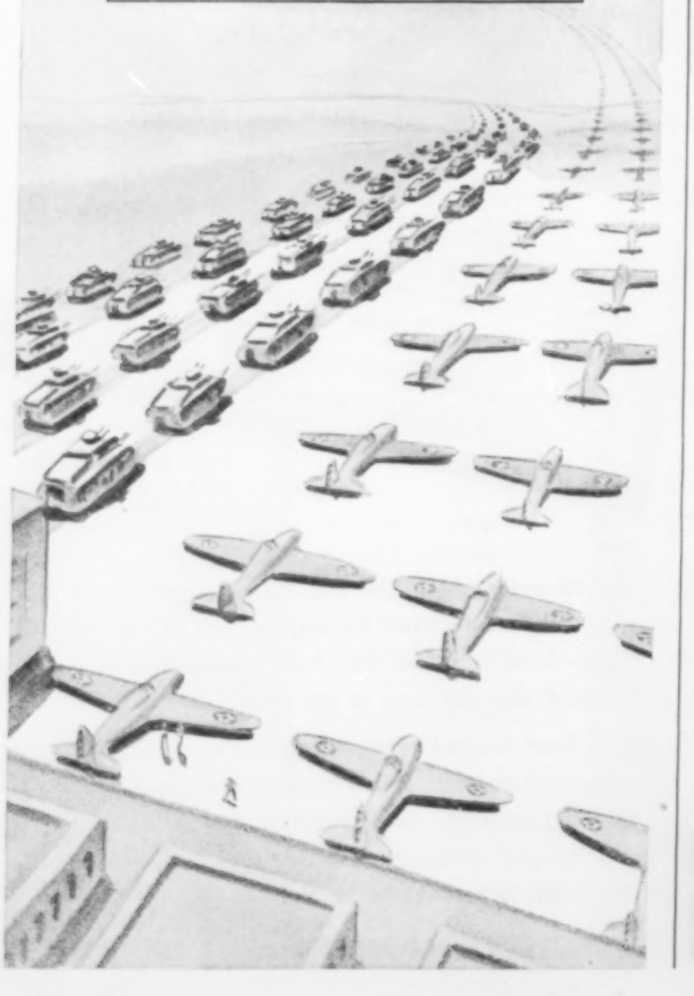
GARLOCK PACKINGS

Help Keep 'em Rolling off the Production Line!

From coast to coast and from Canada to Mexico, American industry is depending upon the quality built into all Garlock products to help maintain the high production schedules which our National Defense program requires.

THE GARLOCK
PACKING COMPANY
PALMYRA, N. Y.

In Canada: The Garlock
Packing Co. of Canada
Ltd., Montreal, Que.



Silence is relative. On a still mountain lake the faint splash of a paddle makes a noise you'd never hear on a rushing stream. There are wide differences, too, in the noise level surrounding different plants. Some operate in industrial sections, some in semi-residential zones, some only during the day, some around the clock.

With Maxim Silencers you can select a standard silencer which is made to fit your particular problem . . . you buy just the degree of silencing you need, no more, no less. Write for details.

THE MAXIM SILENCER CO.
85 HOMESTEAD AVE. HARTFORD, CONN.

COMPRESSOR EQUIPMENT

STURDY • SOUNDLY DESIGNED

JARECKI VALVES

Sizes and types to meet every condition, each soundly built, perfectly threaded and individually tested.

ERIE UNLOADER

Maintains constant pressure by governing inlet of compressor. Loads and unloads without shock or strain.

ERIE GOVERNORS

For steam engines, pumps or compressors. For speed control only or for combined speed and pressure control.

JARECKI FITTINGS

Air-furnace malleable fittings . . . close-grained, cast iron fittings, all with perfect threads. A complete line.

JARECKI Manufacturing Co.
ERIE PENNSYLVANIA, U.S.A

PLANE HORSEPOWER . . . OR PLAIN HORSEPOWER

YOU CAN'T HAVE THE ONE WITHOUT THE OTHER

Again Waukesha Power is speeding defense construction. This time it's at East Hartford, Connecticut—helping to build Pratt & Whitney's new plant, which will soon be producing the engines to power speedy pursuit planes and powerful big bombers for our Army Air Corps.

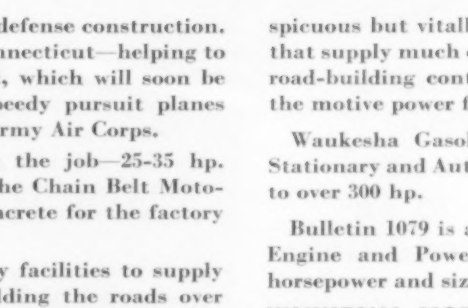
As usual Waukesha is right on the job—25-35 hp. XAHU Waukesha Engines driving the Chain Belt Moto-Mixers that are turning out the concrete for the factory floors.

Whether it's building new factory facilities to supply new weapons of defense . . . or building the roads over which they will be transported . . . or the trucks which will move them . . . Waukesha Engines play an inconspicuous but vitally important part. For it's Waukeshas that supply much of the horsepower for construction and road-building contractors' machinery of all types—and the motive power for trucks and busses.

Waukesha Gasoline and Oil Engines for Industrial, Stationary and Automotive Power range in size from 5 hp. to over 300 hp.

Bulletin 1079 is a complete catalog of every Waukesha Engine and Power Unit with ratings, speed torque, horsepower and size. Send for it today.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.
NEW YORK TULSA LOS ANGELES



★ ★ MORE POWER FOR DEFENSE ★ ★

WAUKESHA ENGINES

Another "ALL OUT" Blaw-Knox JOB

PIPING—
HANGERS—
INSTALLATION

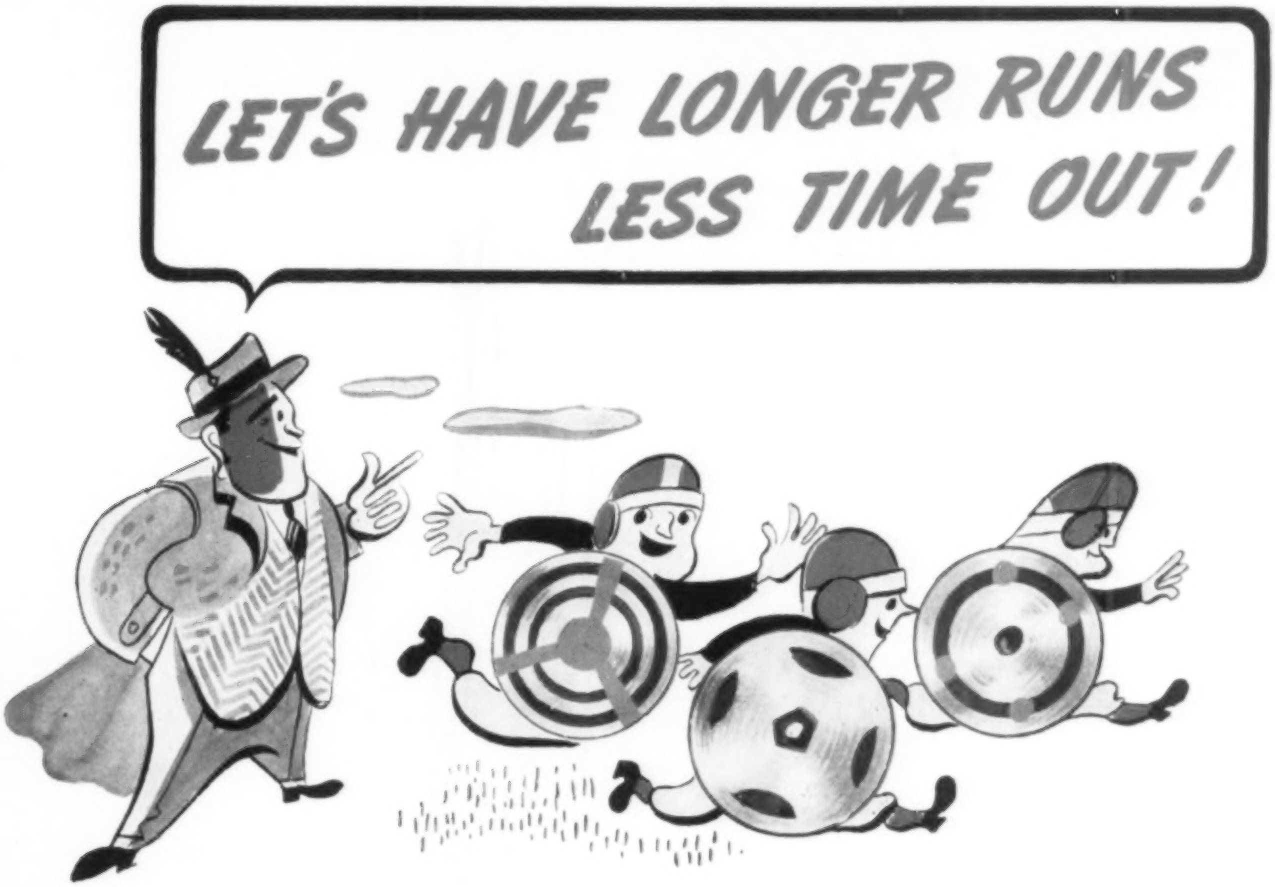
The photographs show another Blaw-Knox high pressure—high temperature installation complete with hangers; the operating pressure and temperature is respectively 900# and 900°F. The Functional Type Hangers used lend themselves admirably to extremely low head room conditions.

All processes in the prefabrication of piping by Power Piping Division are accompanied with proper scientific control necessary to meet the most critical interpretation of current specifications. The facilities of Power Piping Division include six modern plants complete with engineering and research organizations.

A copy of "FLEX-ANAL CHARTS"
To any engineer asking for it
on his Business Letterhead.

Send for Bulletin entitled
POWER PIPING FUNCTIONAL
HANGERS AND VIBRATION
ELIMINATORS

BLAW-KNOX COMPANY
POWER PIPING DIVISION
1525 Pennsylvania Ave., Pittsburgh, Pa.



WHAT this hard-bitten coach asks of his players . . . *you can get* from every one of your compressor valves.

Thousands of valves stay CLEAN, assuring fewer time-outs, higher pressures, lower costs . . . in compressors lubricated with TEXACO.

Texaco Alcaid, Algol and Ursa Oils are highly stable, resist gumming and sludging and prevent the formation of hard carbon deposits. They assure efficient valve action for far longer service periods. Reduce maintenance costs.

The outstanding performance that has made Texaco preferred in the fields listed in the panel has made it preferred also by compressor operators everywhere.

These Texaco users enjoy many benefits that can also be yours. A Texaco Lubrication Engineer will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distributing plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

THEY PREFER TEXACO

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

TUNE IN FRED ALLEN—Texaco Dealers invite you to enjoy Fred Allen in the full-hour program of "The Texaco Star Theatre" . . . with Kenny Baker, Al Goodman's Orchestra and a great cast. Every Wednesday night, Columbia Network, 9:00 E.S.T., 8:00 C.S.T., 7:00 M.S.T., 9:00 P.S.T.

TEXACO
REG. T. M.

TEXACO Lubricants
FOR ALL COMPRESSORS AND AIR TOOLS

RETURN METAL DRUMS PROMPTLY . . . thus helping to make present supply meet industry's needs and releasing metal for National Defense.

TIMKEN
MADE IN U.S.A.

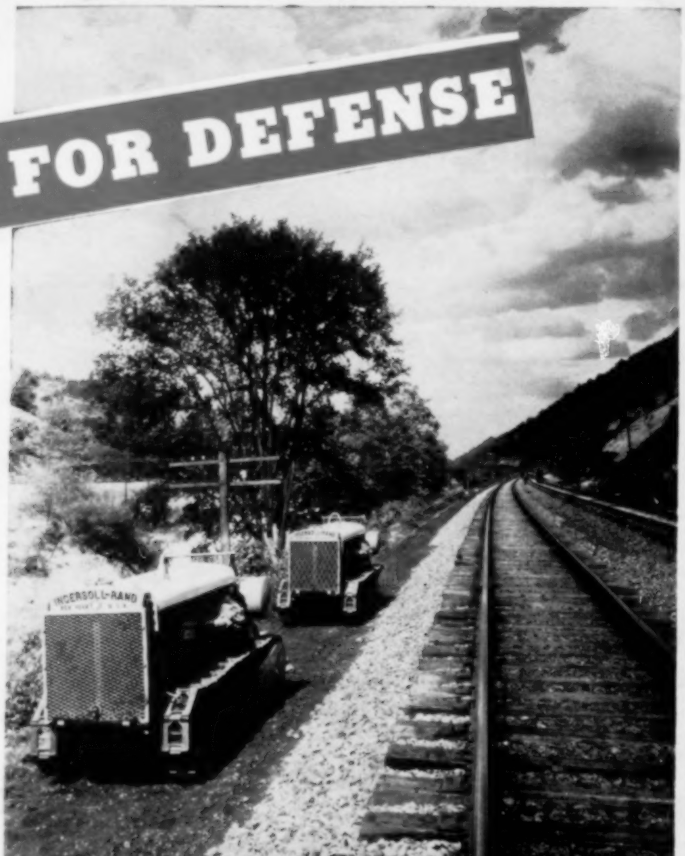
RIGHT OF WAY FOR DEFENSE

Defense transportation is putting a constantly-growing strain on the railroads, hence the increasing burden of track maintenance.

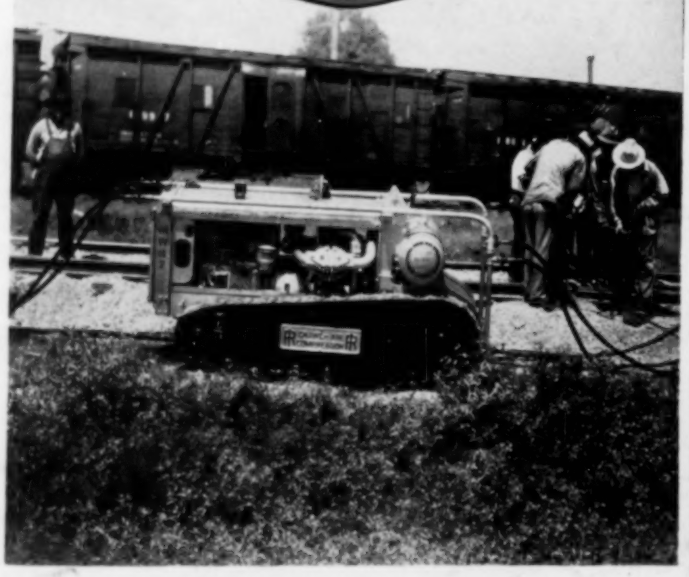
Ingersoll-Rand Crawl-Air Compressor as shown in the photograph is used to supply power for pneumatic tie tampers and other time-saving track tools.

The advantages of this self-propelled compressor outfit for railroad track work are obvious. It can go anywhere. It is independent of the track. It can operate constantly without interruption.

Timken Tapered Roller Bearings are applied to the main shaft of the Ingersoll-Rand Two-stage Air-cooled Compressor to assure the full benefits of anti-frictionization at this vital point. Ingersoll-Rand has used Timken Bearings for years; has proved that they meet every requirement with utmost efficiency and dependability.



TIMKEN Tapered Roller BEARING EQUIPPED



THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing.